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COLLEGE PARK, MARYLAND

Discovery and Growth

Survey of Agricultural Research in Maryland

EIGHTIETH ANNUAL REPORT

BULLETIN A-159

APRIL 1970

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1966-1967

ERSITY OF MARYLAND
ULTURAL EXPERIMENT STATION

BULLETIN A-159
COLLEGE PARK
MARYLAND
APRIL 1970

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1966-67

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COLLEGE PARK, MARYLAND

To The Governor of Maryland,
the Board of Regents,
and the President of the University of Maryland:

I transmit herewith the Eightieth Annual Report of the University of Maryland Agricultural Experiment Station, as established by Act of Congress, March 2, 1887, containing an account of research and experiments conducted during the fiscal year ending June 30, 1967, and a statement of the receipts and disbursements for the same period.

I. C. Haut
Director

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Maryland Agricultural Experiment Station, Administration

AGRICULTURAL ECONOMICS

Dairy Adjustments and Supply Responses in Maryland and the Northeast

The production adjustments in the dairy industry in recent years have resulted in a substantial release of dairy farm labor from the on-farm production process. The total number of milk cows in most areas of the United States, including Maryland, has declined rapidly since 1955. This in itself would reduce numbers of dairy farm workers needed. However, the combined impact of fewer man-hours used per milk cow on farms and higher milk production per cow has further reduced the requirements for total man-hours of farm labor to obtain a given amount of milk output. This report considers the dairy farm labor policy implications of these adjustments within the milk production sector of the economy.

The results of this dairy farm resource adjustment study have a number of implications for Maryland, Northeastern and United States dairymen and the structure of the milk production sector of the farm economy. First, the total dairy farm labor requirement decline has been closely tied to the declining number of dairy farms. Therefore, farm labor will be reduced in the future by a continued reduction in the number of farms keeping milk cows and selling whole milk.

Second, considerable potential presently exists for increased numbers of cows per man on farms with fewer than 80 to 100 cows as well as on those farms with 100 or more cows. Some of this potential can be exploited with relatively small additions to existing capital investments in building and equipment. However, major additions to buildings and equipment will be required to permit most dairy farm firms to fully exploit the large labor productivity potentials that presently exist and may be developed in the future.

Third, the actual release of farm labor resources takes place at the individual farm firm level. This is where the farm labor resource buying and selling process actually occurs. The labor employer agrees to pay certain cash and non-cash benefits for labor resource services and the employee agrees to accept these benefits in return for providing specified labor resource services during a future time period. The labor exchange process in an economy without human slaves involves only the sale of labor services for a limited period of time and not the entire future flow of potential labor services represented by the human being himself. Generally, inter-sector shifts in labor service stocks and flows are encouraged as off-farm wages and employment opportunities increase for the dairy farm workers.

The increased actual and opportunity costs for farm labor over time have encouraged a substitution of more and better capital facilities and equipment for direct on-farm labor inputs at the aggregate level. This substitution of capital for direct farm labor will continue in the future as dairy farm manager-operators attempt to fully utilize the capacity of the modern labor-saving captial facilities now available.

Fourth, milk production per cow also influences the release of farm labor at the aggregate industry-wide level. Fewer cows will be needed to produce a slowly increasing total production requirement if milk production per cow increases rapidly during the next decade. Fewer cows would mean even fewer dairy farms and fewer dairy farm workers.

Fifth, the entrance of new dairy farm workers into the farm labor market must be retarded or the exit of present dairy farm workers must be increased or some combination of both must occur to achieve a net reduction in the present level of dairy farm workers who are in the farm labor market and who are dependent on the dairy farm enterprise as a livelihood.

Sixth, can the young potential farm workers and existing dairy farm workers be adequately retrained or relocated to compete effectively against non-farm workers for the available non-farm employment opportunities?

The future realization of the existing potentials for the substitution of capital for labor per unit of output at the farm level will be influenced by a number of forces such as the availability of off-farm employment opportunities, the extent and rate at which future capital investments are made in new plant and equipment on individual dairy farms, the purchasing economies available to farm firms with large dairy herds, and the farm level and milk assembly marketing economies available to farmers and milk producers.

The average number of cows per man tended to increase at a decreasing rate as the size of herd expanded from 10 to 100 or more cows per farm in both 1956 and 1966. The rate of increase in cows per man was greatest as herds expanded from 10 to 40 cows per farm. However, the average numbers of man-equivalent were lower and the average numbers of cows per man were higher in 1966 for nearly all of the size of herd groupings than they were in 1956. In other words, the *general relationship between size of herd and cows per man was the same, but it was at a higher level in* 1966 *than* *in* 1956. Farms with 60 or more cows handled 27 cows per man in 1956 compared with 31 cows per man in 1966. The farms with 100 or more cows handled an average of 30 cows per man in 1956 compared with 34 cows per man in 1966.

In 1956, the farm in the 100 or more cow group with the highest labor intensity had 63 cows per man on a three-man farm with 189 cows. In 1966, the farm in the 100 or more cow group with the highest labor intensity had 60 cows per man on a five-man farm with 300 cows.

Over time, the average number of cows per man will continue to rise toward the 60 or more cows per man level found in both 1956 and 1965-66. In fact, this upper limit on cows per man will probably rise somewhat in the future as the most efficient dairymen strive for even more efficiency in terms of *cows per man*. This will mean that the total dairy cow population nationally, regionally and in local production areas will continue to be consolidated into arger but fewer herd operating units. The present number of dairy cows could be consolidated into only one half the present number of farms and he average labor use intensity could be increased to 52 cows per man.

The continued close relationship of the decline in farm numbers to the aggregate release of farm labor resources in local production areas would result in another sharp drop in total man-equivalent needed for a fixed dairy cow population in this area.

Total labor needs with the higher levels of cows per man would be even less if total numbers of cows declined as the dairy cow herds were integrated horizontally. The change or lack of it in total cow numbers will depend on changes in milk production per cow, and the impact of this variable on total milk production and sales for a given production area. If total farm level market demand for milk shipped from these farms does not increase sufficiently in the future to absorb the higher production per cow with a stable milk cow population, *then milk cow numbers will decline in the aggregate even though they increase on a per farm basis.* This type of adjustment has been occurring nationally since 1945 and within the Northeast region and Maryland since 1955.

Project A-18-au

Organization of the World's Agricultural Resources

People who work in human development commonly examine all posible factors affecting the development of a particular person. In this way they gain insight into ways in which they can assist his development nd also into the variety of ways in which the development of an individual can be influenced. People who work in agricultural development *should* commonly examine the great variety of possible factors affecting the development of a particular agricultural economy. In this way we can gain insight into ways in which we can assist the development of an agricultural economy and also into the variety of ways in which the development of an agricultural economy can be influenced.

The concept of a "system of agricultural resource organization," developed in this research project, furnishes an analytical framework for studies of particular agricultural economies. It also provides the development economist with a useful approach to the problem of agricultures' contribution to economic development. As we increase the number of our studies in depth of particular agricultural economies, our competency in influencing agricultural development should increase.

Studies detailing the system of agricultural resource organization have so far been published for Algerian Socialized Agriculture and Rudimentary Sedentary Agriculture in Uganda. Field work for these two studies was sponsored by the Agricultural Development Council. Studies are underway on shifting agriculture in South Central Africa, the plantation in Jamaica, feudal village irrigated agriculture in Iran, and the collective farm in the Soviet Union.

The rational for this study together with some of the research methodology being used in the study is set forth by the project leader in an article, "Analyzing Systems of Agricultural Resource Organization," appearing in the May, 1966 issue of the *Journal of Farm Economics.*

Project A-18-ax

Profitability of Alternative Feed Handling Methods on Maryland and Northeast Dairy Farms

Interest in different methods of feeding dairy cows was relatively small 25 years ago, when the basic structure in which cows were housed generally determined the method of feeding. Hay supplemented by corn silage was the chief source of roughage. Procedures and time requirements for feeding were generally taken for granted.

Pressure for herd expansion was created in part by the adoption of such innovations as free-stall housing, milk parlors, and the mechanized harvest, storage, and feeding of silage. All of these have focused attention on feeding and its relation to the different systems used to handle commercial dairy herds. The method of feeding and the location of stored feed have recognizable effects on management efficiency. In fact, differences in feeding may well be critical in the organization of dairy herds in the next 25 years.

A state and regional study was carried out between 1963 and 1967 to examine the effect that alternative methods of feeding commercial dairy herds might have on farm operations and income in the Northeast.

One of the primary reasons for conducting a study of labor use in feeding was to determine how commercial farmers are now feeding their herds and to observe procedures that have been used successfully to improve labor efficiency. In looking at the present structure and organization of feeding, efforts were made to discover some of the reasons for the variation from farm to farm within individual systems when size of herd was constant.

It is the feeding of concentrates, not of forage, that is chiefly responsible for the difference between the time spent to feed in loose housing and in stall barns. Although the amount of time spent feeding concentrates in a milking parlor is small or negligible, still this method saves from 15-30 minutes per day over the loose-housing system. Time is saved both in sweeping mangers and in distributing grain to the herd.

As size of herd increased with stall farm operations, total time spent in feeding also increased. The fixed component in feeding—getting started, climbing the silo, getting to hay in the mow, assembling grain or sweeping mangers—is an important part of the total. The single biggest increase as herd size increased was in time spent to provide silage for the herd. However it is also true that, on the larger farms, an increasing proportion of the total forage input came from silage.

A small number of the farms fed green-chop forage. When used exclusively, this practice had a strong effect on the time required for roughage feeding on individual farms. Green-chop operations in general are labor expensive and have lost favor among dairymen because of this and because supplies of green feed are not consistently available.

Winter is the period of the year when labor requirements for feeding are greatest on most farms.

One of the most common methods used to mechanize feeding systems on dairy farms has been the installation of mechanical silo unloaders. Whereas farmers first installed a single unloader and transferred it from silo to silo, the general practice today is to have an unloader for each silo used.

Most of the farmers who had mechanical unloaders in their silos also fed their cows in stall barns. As with the unmechanized farms, dairymen with loose housing spent less time feeding a given number of cows than did those with stall-barn systems. Difference in time spent in feeding concentrates explains most of the differences in the averages.

When a man supervises the operation of the mechanical unloader, actual savings in time are small. The principal advantage derived from the use of this machine are savings in physical effort or exertion and in travel time up and down the silo.

One way to look at differences between farms where the same basic equipment is used is suggested in the table. Here, actual records from two farms with systems in the same classification are compared side by side for 6 of the 12 monthly feeding periods.

Both farms feed about the same size of herd, both milk in a stall barn and supply both hay and silage to their milking herd during the winter feeding priod.

Comparison of time spent feeding the milking herd, 2 farms with 75 cows. Stall barns, silage in tower silos, unloaders, Northeastern dairy farms, 1963-64

Month and operation	Farm #1 minutes per day	Farm #2 minutes per day
November		
Hay	50	73
Silage	62	60
Concentrates	28	31
Total	140	164
January		
Hay	59	87
Silage	59	60
Concentrates	29	31
Total	147	178
March		
Hay	22	87
Silage	47	60
Concentrates	27	31
Total	96	178
May		
Hay	-0-	10
Silage	31	-0-
Concentrates	23	30
Green chop	-0-	110
Total	54	150
July		
Hay	15	-0-
Silage	34	45
Concentrates	19	43
Green chop	-0-	105
Total	68	193
September		
Hay	15	35
Silage	44	-0-
Concentrates	24	31
Green chop	-0-	135
Total	83	201
	Farm #1 minutes per day	Farm #2 minutes per day
Average minutes per day, all months	98	172
Average minutes per cow per day, all months	1.2	2.3

About half as much of the time was required to feed the herd on farm No. 1 as on farm No. 2. Some of the reasons for the differences are readily apparent. The most important of these is the green-chop program followed on farm No. 2 which requires excessive amounts of time for this size herd during the spring and summer months—the time of year when other field work competes strongly for scarce labor. Farm No. 2 also relied less heavily than did farm No. 1 on silage for the basic supply of forage. On farm No. 1, silage was fed to the herd every month during the year and was supplemented by limited quantities of hay during the summer months. Stored forage had been incorporated as an essential part of the feeding program and consequently silage capacity on farm No. 1 was almost double that of farm No. 2. During the winter months, the amount of silage fed per day on the two farms was almost the same, however, the supply lasted only 7 of the 12 months on farm 2.

This comparison underscores the importance of how an individual uses his equipment and plans his feeding program. It also indicates that the use of green chop or the lack of green chop for feed is a major component in individual differences, particularly in the summer months, for time spent in feeding.

The removal and feeding of silage stored in tower silos becomes fully mechanized when augers and conveyors are used in conjunction with mechanical unloaders. Increasingly, farmers who rely heavily on silage as the primary stored forage throughout the year have employed this method of feeding for the dairy herd whether they are housed in stanchion barns or in free-stall or loose-housing systems. The higher the proportion of silage to hay, the greater the labor efficiency gained by the use of a fully mechanized system.

Project A-18-ay

Optimizing Returns to Resources on the Eastern Shore of Maryland

In view of the widespread technological and economic changes taking place in Maryland agriculture such as adoption of more mechanized practices, development of higher yielding crops and livestock, enroachment of suburbanization on the rural countryside which have led to increased capital requirements, declines in the number of farms and increasing size of farms, this project was developed. Purposes are: (1) to determine the farm product mix and accompanying resource mix which would result in greatest net returns to resources used in farm production, (2) to determine the structure of economic activities which would result in maximum resource earnings, and (3) to measure the impact of prospective changes in agriculture on resource use including services provided by both private and public organizations with particular reference to agriculture on the Eastern Shore of Maryland.

To determine the interdependencies or influences of changes in one sector of the agricultural economy on other sectors of the economy, data were assembled for construction of an input-output table for Maryland agriculture. This table will show the total dollar value of output from each of 14 agricultural production sectors and the purchases of goods and services of each sector from each other sector including approximately 40 non-farm industries. Tentative conclusions of this analysis indicated that the total farm sector purchases about 82 cents worth of goods and services including purchases from the farm sector for each one dollar's worth of output in farm value.

In a second part of this study, data were collected from a sample of 50 farms in each of four counties on the Eastern Shore of Maryland. These data include a description of the kinds and quanities of resources used in farm production, total capital investment and a description of the kinds and quantities of products produced during a period of one calendar year. These data will be used to determine the costs and returns from each type of enterprise included according to size of the enterprise and other characteristics.

The accompanying picture shows a machine which is used on one of the sample farms. This machine is indicative of adjustments being made on farms to surmount the problem arising from scarcity of farm labor and the effects of this on capital investments. These data will be used in a linear programming analysis to determine the effects of changes in prices and costs on optimum resource use.

Project A-18-ba

Maryland Farm and Open Country Real Estate Transfers

This project deals with Maryland farm and open country real estate transfers. The specific objectives of this study are: (1) to discover the number of farm and open country real estate transfers in Maryland by county and election district, (2) to obtain information regarding the price of this land, (3) to discover the size of the tracts being transferred, (4) to obtain information on the types of transfer, and (5) to obtain information on the use of credit, type of lender and other pertinent information shown on the Property Transfer Record.

Since land is agriculture's primary resource base, and because it has been increasing in price very rapidly during recent years, it is desirable that we know more about the market for Maryland farms and open country real estate.

Three computer programs have been developed to process and analyze the data with respect to: (1) consideration, (2) financing, and (3) assessment.

The consideration program examines, for each county and election district, the transfer for which there was a consideration. This program sorts the land transfers into 10 size categories and shows the number of transfers, total acres transferred, average size of transfer, total consideration and average price per transfer and per acre for each of the 10 size categories. This program then summarizes the previously-mentioned information without regard to size categories.

The credit program examines—for each county and election district—transfers involving the use of credit. The program shows, with respect to eleven categories of lenders, the number of transfers, total acres transferred, total consideration, total amount of credit used and the credit as a percent of the total consideration. It also shows the percent of transfers, acres, consideration and credit furnished by each of the eleven categories of lenders. This program then summarizes the previously mentioned information without regard to type of lender.

The assessment program examines—for each county and election district—all the transfers for which there was a recorded assessment. One part of the program shows, for five land use categories, the number of transfers, total acres transferred, total assessment, and assessment per acre with percentage of transfers, acres and assessment for each of the five categories. This program further shows, with respect to transfers with or without buildings and for all transfers, the total acres transferred, total assessment and assessment per acre.

This computer program also makes an assessment and consideration analysis for improved land, unimproved land and for all transfers. It shows the number of transfers, total acres transferred, total assessment, total consideration, average assessment per acre, average price per acre and assessment as a percent of consideration.

Nine county reports were published from this project during the fiscal year 1966-67. These county reports were published with a standard title, "The Transfer of Farm and Open Country Real Estate in . . . County, Maryland, 1964." Reports were published for the following Maryland counties: Allegany, Anne Arundel, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles and Dorchester.

These county reports were distributed to farmers, assessors, credit agencies, county planning groups, agri-business personnel, Extension agents, vocational agriculture teachers, administrators and individuals with an interest in the land market.

The collection and processing of Property Transfer Records for subsequent years was continued.

Project A-18-bb

Comparative Impact of Current and Alternative Systems of Taxation in Maryland on Farms and Other Economic Groups and Among Counties

Property taxes are not the only tax usually considered as a burden upon farmers. Appraisals of farms for state inheritance and federal estate taxation occurred about one-fifth as often as farm tract sales in the seven more urban Maryland counties during the three years, 1964-1966. Appraisal values of the 389 tracts of deceased farm owners averaged about $1,000 per acre, with ranges from $400 to $1,725 per acre among the counties. These values were about two to five times the assessment values for farm property taxation, since farm land assessments are based upon agricultural use value rather than its highest use value or market price.

The high appraisals for death tax purposes creates serious problems to heirs who wish to continue farming, because the tax liability (especially that of the federal estate tax) can necessitate either selling or heavily mortgaging the farm. Moreover, they result in two widely different valuations used by the state within the same year for two different state tax purposes.

One reason for rising real estate taxes in Maryland is the gradual exemption of tangible personal property, especially from county tax rolls. During the ten year period 1956-1966, the real estate taxable basis nearly doubled, whereas locally assessed tangible personal property decreased 15 percent. Farm personal property is exempted from state property taxation, and is rapidly being deleted from county tax rolls. Likewise, for county purposes, the personal property of nonfarm businesses and industries is also gradually being exempted.

This means that real estate will, in the near future, become practically the sole property tax resource of counties. Farmers' investment in real estate averages large in comparison to personal property investments. This is in contrast to the relatively larger investment in personal property as compared with real estate of commercial and industrial enterprises. Thus, the policy of personal property exemption will give relatively less tax relief to farm owners than to other business and industries.

There are other aspects of the problem of failure to fully and currently utilize the taxable resources of local units. An important factor is the lag in placing current property values on the assessment rolls, or in making current effective use of the tax resources at hand. This lag arises largely from several sources: (1) the property tax law which does not provide for increasing assessment values when land changes to higher uses between the dates of finality (January 1 to December 31); (2) the liberal interpretation of the farm land use value assessment law which results in the lower farm use assessment value on land obviously moving in the direction of nonfarm use and/or being farmed on a minimal basis; (3) inability of assessors, because of the work load in rapidly growing areas, to keep current with new properties and the review of existing properties; and (4) the use of prior year taxable basis as a criteria of county ability and effort, in conjunction with state aid for county functional programs, especially public education.

Publications to date (October 18, 1968) on this project are:

Maryland Agricultural Experiment Station Misc. Pub. No. 639—Farm Ownership Valuation and Taxation in Rural-Urban Maryland, December, 1967.

Maryland Agricultural Experiment Station Misc. Pub. No. 643—Trends in Tax Resources of County Governments in Maryland, March, 1968.

Project A-19-ac

Demand for and Availability of Land and Water Oriented Recreation Facilities in Maryland: Economic Analysis

Two recreational activities were studied in detail in 1966-67; campgrounds and marinas.

1. A complete survey of privately owned commercial campgrounds in Maryland was conducted. Location, size, facilities, and services were determined for 34 campgrounds. Some attendance records were obtained for the summer of 1966, and limited investment and operating costs were obtained. Fees charged to the camper for his stay and for extra services were determined.

Campgrounds were concentrated around Ocean City on the Eastern

Shore and in Garrett County in Western Maryland. The more successful areas carried on the campground activity as their major one, at least for the summer season, and had either a sideline recreational activity such as private swimming or boating, or were near a major recreational center. Electricity and water outlets were being added for trailers, and clean and adequate washrooms were desired.

2. All marinas with 10 or more slips in Maryland were surveyed to determine location, size, facilities, and services; 308 were located. A mail survey, completed for about one-third of these marinas, determined the type and amount of slip rental fees. A sample of 17 were interviewed for detailed investment and operating costs. A cost structure from these and supplementary standard costs was determined for model marinas of five different sizes of a limited service type.

The greatest concentration of marinas was in Anne Arundel County around Annapolis. The average number of slips per marina was 64 and the average investment was about $104,000 per marina. The number of marinas had been increasing and plans were being made to expand many marinas to meet rising demand. The sample of marinas showed 60 percent fixed and 40 percent variable costs, with labor the largest single cost—28 percent of all costs. By size of marina, costs per slip declined from the 50 to 150 slip level and increased slightly to the 300 slip size. Maximum economies appeared to exist close to the 150 slip marina.

Publications:

Tuthill, Dean F., *A Guide to Private Campgrounds in Maryland,* Cooperative Extension Service Leaflet No. 55, May, 1967.

Lyon, Gale H., *Economic Analysis of Marinas in Maryland,* unpublished Doctoral Thesis, May, 1967.

Project A-19-ad

An Analysis of the Effect of U.S. Farm Policies on Maryland Agriculture

The voluntary feed grain program became effective in 1961 and Maryland farmers were encouraged to divert portions of their base acreage to soil conserving uses in return for government diversion payments and for eligibility to place certain feed grains under loan. In general, Maryland growers have not participated extensively in this program. Approximately one-fifth of the eligible Maryland growers have signed contracts to participate in the diversion program. Furthermore, since Maryland is a minor producer of feed grains, annual variations in production generally have little influence on price compared to the supply situation in the nation as a whole, and Maryland producers are at a price disadvantage if local production declines while output is up in the Midwest. Finally, yield per acre of feed grains in Maryland changes from year to year largely as a result of variations in weather conditions. These changes are frequently substantial enough to override the influence of participation in the feed grain program on feed grain production. Therefore, the study clearly indicated that it is virtually impossible to precisely measure the impact of the feed grain program on either the production or price of feed grains originating in Maryland.

Under the acreage allotment and price support program prevailing in the flue-cured tobacco belt, yields per acre were stimulated to the extent that quality deterioration was observed and a combination acreage-poundage program was adopted to reduce the economic incentive of increasing yield per acre and to encourage better quality production. In this study an application of the acreage-poundage program to Maryland production and handling conditions indicated that: (1) Yield per acre distribution between farms in Maryland is much greater than in the flue-cured area. (2) The yield per acre of Maryland tobacco has not yet reached the point where quality deterioration is evident. (3) The application of acreage-poundage to Maryland conditions would benefit producers who were least efficient and least interested in the production of tobacco as a business enterprise, while those commercial tobacco growers in the state who are trying to improve their efficiency of operation and quality output, would be subject to output restrictions compared to the existing program.

As a consequence, it was concluded first that yields per acre of type 32 tobacco had not reached a critical stage in relation to quality. It was evident that producers having the highest yields per acre in this state also produced the best quality tobacco. Second, the application of an acreage-poundage program to Maryland conditions would injure the bona fide commercial tobacco growers and benefit those who were usually least efficient and rather indifferent to quality production.

Project A-19-ae

Analysis of Effects of Economic Development in Spain on the Demand for United States Agricultural Products

This work is being conducted in cooperation with the Economic Research Service, U.S. Department of Agriculture. The project has involved extensive field work in Spain by a team of economists from the University of Maryland.

The study was broken into three parts: (1) analysis of Spain's demand for agricultural products, (2) analysis of Spain's supply of agricultural products, and (3) analysis of Spain's trade policy as affected by her rapid economic growth.

Using time series and cross section analysis, income elasticities and expenditure elasticities of demand were developed for agricultural products for Spain, both in 1964-65 and for 1975 (projected). Spain's income elasticities of demand for selected agricultural products for 1964-65 are listed below:

Product	Income Elasticity of Demand 1964-65
Poultry	2.57
Beer	1.58
Edible Oils (non-olive)	1.44
Eggs	1.20
Cotton	.65
Citrus Fruit	1.20
Edible Animal Fat	.82
Wine	.29
Pork	.62
Beef and Veal	.90
Mutton, Lamb, Goat	.48
Vegetables	.57
All Meat	.70
Other Meat	.65
Total Fats and Oils	.28
Fresh Fruit (non-citrus	.63
Sugar	.93
Feed Grains	.83
All Edible Oils	.12
Milk	.38
Potatoes	.11
Olive Oil	-.69
Tobacco	.33
Bread Grains	-.38
Rice	-.29
Pulses	.01
Wool	.32

The supply analysis showed that Spain's crop production was not very responsive to changes in demand. However, production of some types of livestock was responsive to demand. Those livestock products showing the most rapid supply response to increases in demand were broilers, eggs, and pork. Beef, mutton, goat, and milk products were much less responsive to changing demand in Spain.

As a result of the great increase in demand for animal products in Spain and the slow increase in animal feed production there, the U.S. has greatly expanded its exports of feed grains and protein meal (in the form of soybeans) to Spain. This trend will continue through 1975, particularly if Spain is able to continue a favorable balance in its trade with the rest of the world.

Project A-26-bm

Sub Project A

The Impact of Ocean Freight Rates on U.S. Comparative Advantage for Agricultural Exports to the European Economic Community

This study involved a detailed analysis of the costs of shipping agricultural products from interior points through various U.S. ports to the European Economic Community and other points in the world. Data collected showed that though freight rates from the U.S. are generally higher on a mileage basis than from most other points in the world, freight rates as a cost of shipping agricultural products run only around 10 percent of the value of the landed product. Thus, a 10 percent change in freight rates would amount to only a 1 percent change in the landed cost. It was concluded that ocean freight rates that may discriminate against U.S. shippers do not greatly affect the pattern of U.S.

agricultural exports or the competitive position of the U.S. agricultural exports in world markets even though the sum total of such discrimination amounts to several million dollars.

Project A-26-bm
Sub Project B

Agricultural Export Planning in India

India is the world's largest democracy and the largest developing country in the free world. She has set up extensive machinery to plan her agricultural exports to maximize her foreign exchange earnings. She is being watched by other developing countries in this area for what lessons they might learn. Her export planning experience will serve as a guide for these countries. What they do in this area can affect U.S. agricultural trade.

Research was conducted on the planning process in India and its impact on the country's agricultural exports. It was found that while India wanted to exercise control over the level of her agricultural exports and thus over her foreign exchange earnings, she was virtually powerless to do so for the following reasons:

A. Agricultural production is in private hands and there is little the government can do, other than through price incentives, to get farmers to increase production of products salable in the export market. The goverment lacks the financial resources needed to maintain an extensive price support program.

B. Agricultural planning is not controlled by the central government but by the various state governments. The states are more autonomous than state governments in the United States and frequently ignore the wishes of the central government with respect to agricultural production and marketing.

C. India's population is expanding so rapidly it consumes most exportable agricultural items as they are produced, leaving little for export.

D. Crop yields in India are unstable due to the variability of the weather. Therefore, it is quite difficult to plan production and exports with precision.

Project A-26-bm

Sub Project C

Analysis of Processing Efficiency and Costs in Broiler Processing Plants

Due to the difficulty of obtaining reliable cost figures by means of interviews and questionnaires, this study is attemping to utilize secondary data to compare the cost of processing broilers on the Delmarva Peninsula with the processing costs of major competing areas. The purpose of this comparison would be to provide an estimate of the long-run competitive position of the Delmarva broiler producers.

Project A-26-bo

Alternative Marketing Sytems for Eggs in the Northeast

During the period July 1, 1966 to June 30, 1967, interviews were held with industry leaders regarding alternative marketing systems for eggs, with special emphasis on problems of egg price determination. As a result of these meetings, the development of a computer simulation model of the egg industry was begun. This model will be used to test the impact of alternative methods of egg price determination with special emphasis on the role of middlemen.

During this period, an effort to estimate the demand for eggs at wholesale, with special consideration being given to seasonality of demand, was begun. This study is using monthly data and a system of simultaneous equations to develop an estimate of demand that will be useful to the egg industry.

To date, one report has been published by R. W. Schermerhorn and G. E. Reid. *The Market Structure and Organization of the Maryland Table Egg Industry,* Misc. Pub. 596, November, 1966.

Project A-26-bq

Structure of Livestock and Meat Marketing in Maryland

A complete survey of all facilities that slaughter and process red meats in Mayland provided the primary demand data required in building a livestock marketing simulation model for the state. Other data obtained to be included in the model were: (1) transportation costs from the 23 supply areas to each alternative primary demand area, by kinds of livestock; (2) space allocated to handling livestock being marketed, by alternative markets; and (3) marketing charges levied by alternative markets for each kind of livestock handled.

Also, basic data were developed for the regional research project (SM-27). Included were costs of various feedstuffs for 1962 and 1965, the number of beef cattle feedlots by estimated size categories, and a typical ration fed beef cattle (slaughter type) in the state.

Project A-26-bp

The Impact of Institutional Factors on Milk Assembly, Processing and Distribution Systems and Practices

This study, which was concerned with the Washington, D.C. metropolitan market, indicated that the institutional environment of this market changed rather substantially in the decade following the end of World War II. These changes were closely associated either as causes or consequences with marketing systems and practices.

The role of producer cooperatives was materially altered by virtue of Supreme Court decisions which prevented the major cooperative in the market from becoming also a major fluid milk processing and distributing organization. This institutional change significantly altered the competitive structure of the processing and distributing systems in the Washington, D.C. market.

A Washington, D.C. metropolitan health regulation change authorized fluid milk producers to use chemicals, primarily chlorine, to sterilize their milk handling equipment on the farm. This change contributed materially to the complete transition from milk handling and delivery in cans to a system involving cold wall tanks on farms and farm pickup and delivery to processing plants in bulk tank trucks.

The voluntary termination of the federal minimum producer price order no. 45 on March 26, 1947 re-established a producer price bargaining system between the major cooperatives in the market and individual handlers for more than a decade. Under this sytem, the proprietory milk handlers in the market successfully initiated a program of milk solicitation from independent producers by "riding the co-op's blend" and thereby offering a price somewhat higher than the co-op's blend for all milk delivered by producers who were not members of a cooperative. This was possible because the producer milk thus purchased was sold almost exclusively in fluid form and would have cost the handler the Class I price had he purchased from a cooperative.

In order to stop this practice the cooperative again petitioned for a federal order which would require that all handlers pay the same minimum price for Class I milk regardless of its source. This order was made effective in June 1959. As a result, the method of establishing Class I and Class II prices again became primarily a function of federal regulation, and bargaining, which had been between the cooperative and handlers, again became a process of negotiation after public hearing largely between the cooperatives and the Secretary of Agriculture.

Thus, the institutional environment, as well as the marketing systems and practices in the Washington, D.C. market were altered in material respects during the decade following World War II. These institutional changes were influenced to a major degree by the efforts of the milk trade organizations individually and collectively to alter or adjust to their institutional environment.

Project A-26-br

The Role of Farmer Cooperatives as Marketing Organizations

Farmer owned marketing associations, many of which were originally organized as bargaining cooperatives, have now become involved in many additional functions related to the improvement of their member's farm incomes. In defining a marketing cooperative as one which derives over 50 percent of its gross dollar volume from marketing farm products, we find associations which, while traditionally known as marketing cooperatives, are in reality purchasing or service cooperatives.

Of the five marketing cooperatives studied, all are integrated to some degree. The most obvious are those which have supply branches or processing plants on wholesale and retail marketing outlets. All are engaged in the many less obvious service activities which may complement or supplement their marketing activities and may or may not be departmentalized activities easily separated from the other major functions of the cooperative.

The less than $90 million value of raw products marketed for members does not reflect the role of the marketing cooperatives in servicing Maryland farmers.

The role of price bargaining is not always reflected in the price of the product. In an industry facing increasing costs and reduced prices, the cooperatives are constantly concerned with the competitive market, market development and recently, synthetic products competing with farm products.

The problem of quality control, demanded by the more sophisticated consumers, is not only a matter of products inspection but includes management assistance. This is a service generally provided by today's marketing cooperatives.

The expansion of purchasing activities, the integration of marketing activities from the farm to the consumer, and the many related services, do tend to reduce costs to farmers and increase returns for farm products. There is, perhaps, some need to investigate the efficiency of the integrated cooperative activities to determine whether the member producer is best served by all cooperatives getting into the act and perhaps providing overlapping services.

The successful marketing cooperatives do have loyal members who look to their own organization for additional services, but it must be determined if each cooperative can effectively provide all services.

Project A-26-bs

Evaluation of Market Structure Performance in Marketing Northeast Fruits and Vegetables

Interviews were completed with 52 Maryland growers of tomatoes, sweet corn, and green beans who represented about 25 percent of the acreage of those crops currently being grown in Maryland. The data from these interviews has been tabulated and are being analyzed. The major findings were:

1. Growers interviewed indicated that their acreage of the crops under study changed very little during the period 1960-1965. Major factors limiting change in acreage were availability of labor and lack of demand at favorable prices.
2. Forty percent of these growers changed varieties during the period 1960-1965. Most of these were tomato growers who made their change at the suggestion of their buyers.
3. Growers felt that buyer grades did not accurately reflect consumer wants, and they were equally split on whether prevailing grade-price differentials properly reflected quality differences.
4. Improvements suggested for the present grading systems were for buyers to pay on a grade-out basis, and the need for more consumer information on grades was stressed.
5. With the exception of the green wrap tomato growers, who marketed their products through packers, growers marketed through commission men on rather informal arrangements. No written contracts were involved in any of the dealings.
6. The majority of growers responding indicated that they were satisfied with their present selling arrangement. In addition, a similar proportion of growers stated that they were satisfied with current profitability levels. Recommendations for improvements in grower-buyer relationships were: (1) more buyers were needed; (2) growers should be paid on a grade-out basis; and (3) growers and buyers should develop a brand which would emphasize Maryland grown products.
7. Almost all the growers recognized that competition from other areas of the country had considerable effect on the market for their products. However, only the green bean growers thought that the processed form offered competition to the fresh product.
8. Details of cost to market Maryland produced tomatoes, sweet corn, and green beans are presented and analyzed.
9. Growers indicated that marketing costs had increased during the period 1960 - 1965. Major cost increases were: (1) commission fees; (2) containers; (3) labor; and (4) general farm supplies. Indications were that the future would bring similar upward pressures on cost for the same general reasons.

General plans and procedures were developed for the initiation and implementation of phase two of the project. This was a study of the first handler, wholesaler and retailer (chain store warehouse) level of market structure for Maryland produced fresh market tomatoes, sweet corn, and green beans.

Project A-26-bu

Economic Analysis of the Market Structure of the Commercial Fishing Industry in the Northeast

Time series data on the consumption and price of various fishery products were collected. Work was begun on the estimation of demand functions for the following commodities: (1) canned tuna, salmon, sardines, and mackerel; and (2) fresh and frozen shrimp, clams, crabs, lobsters, haddock, and halibut.

An extensive amount of catch data for the Chesapeake Bay was collected. Analysis of monthly catch data showed that the catch of all major finfish and shellfish species was highly seasonal. Analysis of annual catch data indicated significant upward trends for crabs, clams, alewives, flounder, menhaden, scup, sea bass and striped bass.

Secondary data on the Maryland and Virginia seafood processing industry were assembled. The industry is characterized by a large number of firms with relatively small output. The processors are chiefly engaged in crab-meat picking, oyster shucking, and clam shucking. Several relatively large plants in the Reedville, Virginia area process menhaden for oil, meal and solubles. Regression analysis showed a close relationship between the Chesapeake Bay catch and the output of the processing industry.

Project A-26-bv

An Analysis of the Forest Marketing Structure in Maryland

Data were obtained from owners of forest land and sawmill operators in Maryland. Approximately 120 sawmill operators were included in the survey. Information concerning the size and scope of the industry, industry sales procedures, characteristics of the businesses and the operational practices of the sawmills were obtained.

Owners of forest lands were surveyed to determine marketing practices followed in selling timber.

A second general mail survey concerning those Maryland residents producing Christmas trees was initiated. This first survey was to determine interest and willingness to participate in a detailed cost of production and marketing study related specifically to Christmas trees.

Project A-26-by

Structure of Maryland Grain Prices

Maryland was divided into districts based on freight rates from the nearest freight basing point to the west of Maryland-Toledo, Ohio. These freight rate districts were mapped to show the number (26) and approximate boundaries. To facilitate handling the grain price data to be collected, the various freight rate districts were aggregated into five major areas. Weekly prices for corn, wheat, oats, barley and soybeans for the period 1964 - 1967 were collected. These price data will be analized to isolate the seasonal, the cyclical and the trend components.

A questionnaire was developed for obtaining selected data from grain dealers in the state. This sample was selected at random. About one-half of the schedules have been administered.

Project A-26-bz

AGRICULTURAL AND EXTENSION EDUCATION

Recreation of Non-resident Property Owners in Garrett County

This study in Maryland's far western Garrett County, which is mountainous and moderately forest covered, reported considerable socio-economic and behavioral data and preferences for about 2,500 non-resident property owners located both on the large Deep Creek Lake and in upland portions of the county.

Substanial differences in socio-economic characteristics, values and expectations were found between the non-resident Deep Creek and upland property owners. Water-oriented, seasonal residents generally lived closer to Garrett County and were more frequently from smaller cities and suburban areas compared with the higher proportion of rural and large city residency of upland seasonal residents. Most non-residents were employed in the professional, managerial or craftsman occupational categories. However, there was a higher proportion of professional, managerial and sales occupations in the Deep Creek sample and a higher proportion of craftsmen and operatives in the upland sample. Educational attainment and total family income were greater among the Deep Creek sample than among the upland sample.

Deep Creek property units generally had less acreage, but dollar value of the property was higher. Non-residents owning Deep Creek property acquired it more recently than the upland owners. Most Deep Creek property was acquired with the intent of seasonal residential use. Although seasonal and recreational intents were also important to upland owners, a larger proportion identified income and investment-related reasons for owning their upland property. The upland owners indicated local family ties among the reasons for owning their property. The uplanders also did more social visiting, but this is related to the fact that they had more family ties in the county and visited more with relatives while in the county.

Facility sports — skiing, golfing, camping, and horseback riding—were comparatively low by both groups. Also low, but not so uniformly for both groups, were formal social activities, indicating a strong preference among both groups for outdoor activities. Altogether the activities displayed a rich variety with water sports and other outdoor functions predominating.

Project T-12

The National Young Farmer Study: Patterns of Effective Class Organization and Course Conduct

Agricultural educators continue to attempt to identify the most effective approaches to organizing and conducting evening classes for adults. In a recent study, as a part of a larger national study, reactions of 1,773 young farmers enrolled in evening classes in agriculture at 163 schools in 38 states were obtained.

It was found that the young farmers enrolled were much more satisfied with the course when they participated in planning the course content and in plans for the conduct of the course. Interest among those enrolled was higher when the class was formally organized with officers and business meetings were conducted at some but not all of the class meetings. However, students' opinions of the instruction was higher when the business meetings were not held during or with instructional meetings. Social and recreational activities were found to be important to successful courses and increased in importance for those classes which were formally organized and conducted business meetings at instructional meetings.

Project T-13

AGRICULTURAL ENGINEERING

Applications of engineering in agriculture promote efficient production, harvesting, transportation, processing and marketing of plant and animal products and the conservation of natural resources. These functions are accomplished through the application of energy to transform the crops or products or to control the environment in which these are grown, stored, processed, or marketed.

In cooperation with scientists of other disciplines, engineers seek to determine the essential environment for biological processes and the changes in products necessary to enable their use. The engineering task is then to seek the most efficient design for application of the energy necessary for management of biological systems.

It is not possible to undertake all engineering aspects of biological systems in a single department. This summary report includes three projects (RM-1, R-16 and R-20) which specifically contribute to regional research and also two studies of regional and national importance made in cooperation with the Agricultural Engineering Research Division, Agricultural Research Service, U.S. Department of Agriculture.

Farm Waste Disposal

Work was continued on hydroponics as a means of removing plant nutrients from the effluent of farm waste disposal lagoons prior to discharge into streams.

A field test unit (1 foot X 4 feet X 8 feet) was set up in addition to the greenhouse experiments. However, several problems developed and had to be worked out so that the only significant data obtained was from the greenhouse experiments. Brome and Reed's canary grasses were used in place of the Orchard and Timothy which previously had been unsatisfactory. These grasses were effective in denutrification of effluent.

A five-day detention time in the hydroponic system has shown a nitrate reduction of 79.5 percent using fescue, 70 percent using rye, 64 percent for Reed's canary and 47.5 percent for brome. These are averages of five repetitions.

A five-day detention time resulted in a phosphate reduction of 66 percent for rye, 63.5 percent for fescue, 54 percent for Reed's canary and 60.5 percent for brome. These were also averages of five repetitions. Much higher values were obtained on some individual tests.

Grass yields ranged from a calculated 4.41 to 8.5 tons per acre with an ash content of from 1.9 to 3.1 percent. At the upper limits of tonnage and ash this is equivalent to a removal of approximately 500 lbs. of dissolved plant nutrients and trace elements on a one month, one acre basis.

Average requirements for a hydroponics system would be 2.2 acres per 10,000 gal. per day effluent discharge (a high rate for a farm lagoon but a good "mean" figure for small municipal sewage disposal lagoons), which gives a five-day detention time.

Farmstead Water Supply

This project is designed to collect farmstead water use information and apply this information in the development of improved design criteria. Major emphasis has been placed on dairy farms and household water use.

Field observations revealed a close relationship between water system capacity and labor efficiency in dairy chores. Farmers who have accepted planning advice have reported reductions of one to two man hours per day in chore time. Improved design has made it possible to increase system capacity over 500 percent while reducing the cost per gallon per minute over 70 percent.

Household water use data was collected in two suburban areas in cooperation with Johns Hopkins University. These data indicate that Hunter's Demand Curve (NBS) provides a reasonable estimate of peak household demand.

Working closely with Fire Service Extension personnel, design criteria for maximizing the fire fighting potential of individual water systems, were developed. These will be used by the Rural Fire Protection Committee of the National Fire Protection Association in a new standard on rural fire protection.

A small automatic atmosperic storage tank was built to continue the hydraulic waste removal studies. Farmers cooperating in this study continue to prefer the largest nozzle furnished them that is matched to the pump's operating characteristics. It is possible to meet nozzle base pressure requirements by improved design of the individual water system, eliminating the need for a booster pump.

Cooperative Project with
Agricultural Engineering Research
Division
ARS, USDA

Tobacco Harvest Mechanization

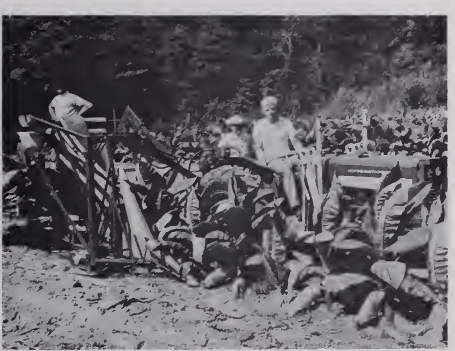
Due to problems of axle location on the Minneapolis-Moline Unitractor, it was abandoned as a power unit for the tobacco harvester. A new harvester was designed, constructed and field tested during the 1967 season. The machine cuts and conveys the tobacco plants onto a pallet for hauling to the spearing area. This unit mounts on a three point hitch tractor cutting the row of tobacco on the right side of the tractor. Corn picker snouts lift the lower leaves of the plant prior to cutting. Two overlapping plow coulter blades cut the tobacco plant. One coulter was notched and driven by a hydraulic motor. The other was smooth and free to rotate when a plant was being cut. The hydraulic motor was driven by a pump on the tractor P.T.O.

The unique feature of this harvester is the belt system used to convey the cut tobacco plants up and onto a pallet and at the same time turn the plant from a vertical to a horizontal position. These 14-inch-wide belts were padded with 2 inches of foam rubber. The belts run in the same direction with the rubber just touching. When the plant is picked up by the belts, the foam rubber holds the plant firmly without damaging the leaves. The belts are driven by a hydraulic motor.

The cut plants were put on a 4-feet X 8-feet pallet transported on a trailer behind the machine. The pallet rested on rollers on the trailer and to unload a full pallet, the trailer was tilted. A full pallet held from 150 to 200 plants. The pallets were transported to the spearing area by a farm tractor with a rear mounted fork lift.

A 3.5 acre test field was harvested and forty man hours per acre was required to harvest, spear and hang the tobacco. This is about a 20 percent saving of labor over the 52 man hours required with conventional methods.

Project R-11-h



Tobacco harvester operating in the field, note the snouts that lift the leaves before cutting of the stalks.

Development of Equipment and Improved Methods for Harvesting Sweet Potatoes

The design was completed and construction started on a proto-type two row, self-propelled, sweet potato harvester. This machine should be in the field for tests in 1968.

Project R-18

The Effect on Market Quality of Sweet Potatoes of Injuries Caused by Known Forces

Work was continued on determining the effect of injuries by known forces on market quality of sweet potatoes. Differences of variety due to abrasive action was again marked with Nemagold most susceptible at low pressures. As the pressure on the abrasive surface increases, there is a leveling off as fresh market quality is greatly reduced on all varieties tested. It is doubtful whether such injury would be serious for processing potatoes as limited tests indicated these abrasive injuries are completely removed in peeling.

Impact tests showed appreciable variety differences in susceptibility to cracking. Bruises, serious enough to reduce market quality, caused cracking of the potato in most cases. Such cracks would reduce market quality for both fresh marketing and for processing.

There was some difference in susceptibility to injury for potatoes harvested from dry ground as compared to those harvested after rain. Work was too limited to draw definite conclusions.

Project R-22

Performance Characteristics of Screw Feeders and Screw Conveyors

Work under this project was continued to include pitches up to one and one half times the diameter of the screw. With the screw axis horizontal, increasing the pitch to these limits tends to increase the output at low speeds. As speed increases output drops off rapidly for these long pitch screws. For a given housing diameter, the limiting output, as speed increases, appears to be constant regardless of pitch. For the short pitch screws, higher speeds are required to reach the limit.

Project R-25

Effects of Fuel Charge Properties on the Performance of LP-Gas Engines

Some effects of controlling temperature and humidity of the inlet air on the maximum power output of an International Model SD-240, six-cylinder engine converted from gasoline to LP-gas were determined. The humidity had no significant effect. However, by decreasing the air-fuel mixture temperature, an increase in power was obtained. Operating at 1600 rpm the engine developed 54.2 brake horsepower at a mixture temperature of 40 degrees F and only 47.6 horsepower at a mixture temperature of 150 degrees F. When compared with a standard engine, the increase in power was approximately 20 percent.

The thermal efficiency of the engine was significantly affected by the temperature of the fuel leaving the fuel regulator. The lower the fuel temperature, the higher the fuel consumption and the lower the thermal efficiency.

The data obtained could contibute to the development of a carburetion system to achieve higher performance from engines converted to burn LP-gas.

Project R-27

Tobacco Housing

Studies were continued on the mechanization of the handling techniques of harvesting and the curing requirements of "compact cured" Maryland tobacco. The object of this study is to develop methods to reduce the labor required to harvest and hang the tobacco and to determine the environmental requirements for compact curing in a temporary plastic covered structure.

Changes made in the facility for this season were the method of unloading the wagons of tobacco and types of heaters used. The tobacco was speared in the field, hung onto tiers mounted on a wagon and transported to a curing facility where the tiers and tobacco were unloaded as a unit.

The upright posts that support the tiers and tobacco were made to pivot at the bed of the wagon, tilting 10 degrees forward. The wagon was unloaded by placing a pipe through the tiers, and as the wagon moved between four poles, the poles pushed back on the pipe rotating the upright post. When the post passed the vertical point, it dropped back and the pipe then supported the load on brackets attached to the post. Approximately six minutes were required to unload a wagon of tobacco i.e., 760 plants or one eighth an acre.

The 1966 season was ideal curing weather and supplemental heat was not required during the curing period. However, during the 1967 season, there was a week of rainy high humidity weather which required supplemental heat to prevent house burn. Two types of heaters were used, each doing an excellent job and meeting a different requirement.

The first was three pipe burners each constructed from 2-inch pipe, 32 feet long. The pipe had .0595-inch diameter holes drilled every foot the length of the pipe. Connected to the pipe was a venturi air mixer for LP gas, a pressure regulator and a 100 pound tank of LP gas. These burners each produced approximately 30,000 BTU per hour.

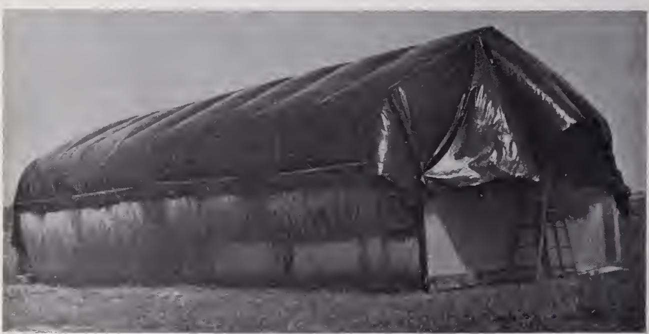
The three pipes were spaced 5 foot apart the length of the facility. Very uniform heat was obtained in the tobacco. Each hole produced a flame about 2 inches high, and kept the temperature in the tobacco between 80 and 90 degrees F. These burners were used to keep the temperature at an optimum level. The plastic was closed and the moisture level allowed to build up. When the humidity became to high the ends of the plastic were opened or the fan operated. During cool dry nights, the pipe burners were operated to give excellent curing conditions without lowering the humidity. However, during rainy high humidity weather, the pipe burners do not remove the necessary moisture. Therefore, it was desirable to operate the fan and heat the entering air. The second type burner used was a portable 300,000 BTU oil burner. This furnace raised the air temperature 10 to 15 degrees F in the tobacco. This lowered the relative humidity about 25 percent, thus removing the moisture from the facility and at the same time slowly drying the cured leaves on the plant.

It is desirable to maintain an air temperature between 75 and 90 degrees F and a R.H. of 75 to 80 percent in the tobacco during curing. However, if humidity is above this level it should be lowered enough to dry the cured leaves on the plant once every 24 hours.

The 1966 crop was of excellent quality and averaged 70 cents per pound on the market. Preliminary evaluation of the 1967 crop indicates excellent quality.

This method required 32 man hours per acre to harvest and hang. Comparing this to the 52 hours required by the conventional method, there is a saving of 20 man hours.

Project RB-11-*g*

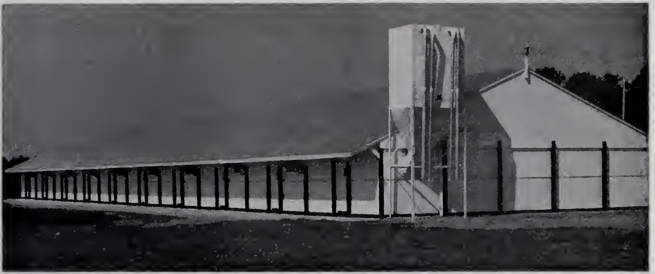


The temporary plastic covered tobacco curing facility. This facility has a capacity of one half acre covering on area of 16'x34'.

Environmental Requirements of Poultry

The year 1967 was spent in design and preparation of plans and specifications and in obtaining bids and supervising construction of an environmental research broiler facility and a physiological laboratory at the broiler facility and a physiological laboratory at the Broiler Sub-station near Salisbury. The environmental facility consists of nine chambers each 20 x 40 feet. The primary work will be in the area of effect of temperature, and air movement on broilers.

Project RM-1



Environment Research Broiler facility at the University of Maryland Broiler Substation, Salisbury, Maryland.

Application of Energy for Control of Insects

The results of the previous three years indicated that flaming could be effective in controlling the alfalfa weevil. Due to the relatively slow application speed (2 mph) and fuel consumption rates (approximately 40 gallons per acre) required for effective control in 1966, major emphasis was placed on equipment development and evaluation.

Techniques to determine the characteristics of the flaming equipment in the laboratory were developed. Based on results of the laboratory studies of two commercial burners, the 1966 field flamer was modified and a new experimental flamer using a different burner was constructed without blowers to supply secondary air. The burner used on the 1966 machine was modified by removing the shield on the inlet of the burner housing. The modification increased the quantity of primary air entrained and permitted the removal of the two centrifugal blowers used on the 1966 machine to supply secondary air for complete combustion. The elimination of the blowers on the new flamer and the 1966 machine lowered both initial and operating costs. In addition to the two experimental field flamers, a commercial flamer was used in the field tests.

The results of the field studies indicated that dormant flame treatments at speeds of 3 mph with the two experimental flamers gave weevil control equivalent to that obtained by a foliar insecticide application. Dormant flame treatment with the

1967 machine at a speed of 5 mph was almost as effective as an insecticide application. Insect damage in plots flamed with the commercial machine was not controlled and an insecticide application was applied at the time check plots were sprayed.

Preliminary results from chemical analysis of alfalfa samples taken at the time of harvest indicate higher quality from plots that received flame treatments.

Project RHB-23

Experimental field flamer in operation.

AGRONOMY

Research in the Department of Agronomy is directed toward the development of improved crop varieties and improved soil, water, and crop management practices that result in more efficient production. Of equal importance is the investigation of the fundamental principles of soils and crops that involve studies ranging from soil formation to the mechanism of weed killers in plants.

The wide range of soils and the 2.1 million acres of agronomic crops (corn, soybeans, tobacco, small grains, turf-grasses, hay and pasture) grown in the state, with a value of approximately 149 million dollars, emphasize the size and importance of the research program in agronomy. To solve soil and crop problems, research work is conducted at the University, on the University farms, and with cooperating farmers, golf course superintendents and others throughout the state.

Soybean Varietal Improvement

Experimental soybean strains were tested at Linkwood and Queenstown, Maryland. On the basis of its performance in these trials, the York variety of soybeans was released in 1967. York produced higher yields and had larger seed size than either Dare or Hill varieties.

Three rates of seeding Kent and Dare varieties, namely 2.3, 5.9, and 7.6 plants per sq. ft., resulted in significantly greater yields at the intermediate rate of seeding. Yields for Kent were 42.1, 48.6, and 42.5 bushels per acre and for Dare 40.0, 44.1, and 35.9 bushels per acre for the 2.3, 5.9, and 7.6 plants per square foot rates, respectively. Row spacings of 7 inches, 30 inches, and 40 inches in the same study did not significantly affect the yields at the low or high rate of seeding. Yields of 43.9, 47.9, and 54.0 bushels per acre for the Kent variety were found at the 5.9 plants per square foot rate.

Project B-43

Breeding for Better Dent Corn

Corn performance in Maryland in the year 1966 was greatly affected by drought.

In the second year of an experiment at College Park on the effects of irrigation, plant population and row width on the yield of a medium-season hybrid, interesting results were obtained.

Supplementary irrigation across other treatments resulted in an increase of 56.5 bushels per acre. With irrigation, a seeding rate of 24,000 across all row widths (20, 30 and 40 inches) resulted in an average of 116.3 bushels per acre as compared to 98.7 bushels for a 15,700 seeding rate. Without irrigation the lower rate produced 54.7 bushels as against 47.3 bushels for the higher rate. The difference of 7.4 bushels, however, was not statistically significant.

At the yield levels obtained in 1966, differences between row-widths were not significant. Hybrid comparisons in replicated tests at College Park, Wye Institute, Linkwood and Hebron were limited in value because of low yields and high variability among replicates.

Project B-50

Breeding Improved Varieties of Forages

Significant differences in yield and persistence of stands were found among 25 experimental strains and established varieties of orchardgrass. The experimental strain NE-28-60-1 (1) was particularly outstanding. The yield in tons per acre and stands in percent ground cover for the two best strains and Pennmead and Potomac varieties were:

	T/A		% Ground Cover (8-22-67)
	1966	1967	
NE-28-60-1 (1)	3.11	3.17	75
NE-28-60-1 (2)	2.88	3.10	54
Pennmead	3.01	3.00	50
Potomac	2.84	2.94	54

The third year data of 9 alfalfa varieties, three of which were new experimentals, were recorded. None of the new experimental varieties were superior in either yield or persistence of stand to the established varieties.

New alfalfa weevil resistant strains of alfalfa were seeded in April 1967 with 4 standard alfalfa varieties. The seedling year observations indicated that the resistant strains have desirable agronomic characteristics.

Project B-56-i

Beef Production on Midland Pastures Increased with Nitrogen Fertilization and Grain Feeding

Production of beef from pastures can be substantial even in a dry season such as experienced in 1966. Gains per animal and per acre were good on all Midland pasture combinations. Yields ranged from 483 pounds of beef with 200 pounds of nitrogen per acre up to 885 pounds of beef with 400 pounds of nitrogen plus light grain feeding.

Results in 1967 were similar but slightly higher. Slaughter grades taken at the end of the season showed increases due both to pasture fertilization and to grain feeding. All grades were slightly higher in 1967. Increased beef gains due to nitrogen fertilization were more economical than those produced by grain feeding. Increased production per acre was due both to higher carrying capacity and improved individual animal performance.

Project B-56-*j*

Wheat Breeding and Evaluation

The current plan of comparing new selections of wheat and other small grains at high, well balanced fertility levels continues advisable. High yields are being obtained on shorter straw with less lodging.

In 1967, yields harvested from replicated nursery plots ranged from 35 to 60 bushels per acre. Bushel weights were good and there was little lodging.

In the 85th-acre replicated drill plot test on Beltsville silt loam soil, yields for 12 named varieties ranged from 30 bushels per acre (old Fultz variety) to 49 bushels (Knox 62). Although plant heights ranged from 39 inches (Monon) to 56 inches (Fultz), there was little lodging in the test, and bushel weights ranged from 57.5 to 61 pounds.

Project B-66

Varietal Improvement in Barley and Oats

For the second consecutive year winter barley and winter oats performed well in the nursery at College Park. The old barley variety, Wong, at 72 bushels per acre, was outyielded by seven other selections including Rogers at 77 bushels per acre. Likewise, in the larger field plot tests, named varieties had yields ranging from 64 to 84 bushels per acre. In this test the new, rough-awned, short straw variety, Zora, made the top yield.

In the nursery the old Lee variety of oats made 94 bushels per acre as compared to Norline at 106 and the top experimental selection at 109 bushels.

It appears that new varieties are available with short, stiff straw and have the ability to perform well at well-balanced fertility levels.

Project B-67

Controlled Climate Helps Understand Plant Growth

Crop growth and development is the product of the genetic makeup of a plant interacting with the environment in which it is growing. Considerable data have been collected regarding plant responses to specific environmental factors but much of this has been obtained in growth chambers under strictly controlled conditions. Although this goes a long way in explaining specific plant responses, it is extremely difficult to translate these data in terms of yield responses in a "natural" field environment.

Equipment for controlling soil temperature and light intensity in the field has been in operation for the past few growing seasons. Both environmental factors were satisfactorily controlled. For instance, temperature control of the soil profile to a depth of 12 inches has been within a few degrees of desired temperature (50, 70, and 90 degrees F).

Forage growth of Climax timothy, S-37, and Potomac orchardgrass was more than doubled with the low soil temperatures. This effect was most pronounced on aftermath production. The increase in tiller initiation and development appears to be the main reason for this added growth. Reduced light intensity had a similar and additive effect on all plants studied. Not only is production affected but the longevity of the stand as well. Tiller development appears to be the key to both production and stand persistence.

Project B-73

Midland Bermudagrass Hay Looks Good

Field experiments over the past several years have produced hay yields of between 8 and 12 tons per acre. Chemical analysis of these hays indicated forages of acceptable quality in most cases.

Animal evaluation of these forages show that both forage intake and digestibility were increased with more frequent harvesting and with higher nitrogen fertilization.

It appears from these data that the best overall performance is with about 400 pounds of nitrogen per acre when the forage is harvested every 20 to 30 days (depending on the rainfall). Earlier harvested material was lower yielding, while more mature forage was lower in quality. Midland Bermudagrass properly fertilized and harvested appears to offer a real potential for much of Maryland. The grazing or harvesting management of this grass is not difficult but precise fertilization and harvesting schedules are necessary to insure high production of quality forage.

Project B-74

Forage Production Can Be Improved with Sod-Seeding

Thousands of acres of permanent pasture as well as improved forage seedings in Maryland can be made more productive by introducing legumes into a grass-dominant sod or by supplementing existing grass with sod-seeded annuals. Crownvetch, a relative newcomer to the forage picture in Maryland, continues to look good. After three years, bluegrass pastures sod seeded with Crownvetch out-produced plots completely renovated to orchardgrass-ladino-red clover mixture. Birdsfoot trefoil sod-seeded into the same pasture increased yields but not as much as the crownvetch. All sod-seeded plots continued to increase in production each year, while the completely renovated plots declined.

Other research has demonstrated that production of Midland bermudagrass can be nearly doubled by sod seeding of cool-season annuals into the existing sod. The seeding of cool-season perennials is slightly less productive than the annuals and more difficult to manage.

Project B-75

Crownvetch sod-seeded into bluegrass pasture on the right. On the left pasture fertilized with 200 pounds of nitrogen.

Experimental seeder used in sod-seeding studies at University of Maryland. Machine developed by USDA Agricultural Engineers, Beltsville, Maryland.

Publications

1. Nitrate nitrogen accumulation in Orchardgrass (*Dactylis glomerata* L.) as influenced by soil temperature, light and nitrogen supply. Allan Barnard Simons M.S. Thesis, Department of Agronomy, University of Maryland. June 1967.

2. Improved soil openers for the establishment of small-seeded legumes in sod. A. M. Decker, H. J. Retzer, and F. G. Swain. Agron. J. 56:211-214. 1964.

3. Sod-seeding of annuals into Midland Bermudagrass (*Cynodon dactylon* L.) pastures. I. Species evaluation. F. G. Swain, A. M. Decker, and H. J. Retzer. Agron. J. 57:596-698. 1965.
4. Dry matter yields stand persistence and plant reserves as influenced by maturity, clipping heights, and nitrogen fertilization of orchardgrass, bromegrass, and reed canarygrass. J. T. Raese, and A. M. Decker. Agron. J. 58:322-326. 1966.

Red Clover Breeding Investigations

Eight red clover varieties were evaluated for their forage yields and persistence. A new synthetic variety, Kentucky Syn-A2, produced yields similar to Chesapeake during the first two years and maintained its stand for three years, a year longer than Chesapeake. All of the remaining varieties which included Kenland, Pennscott, Tensas, Orbit, Dollard, and Kentucky Bean Yellow Mosaic Resistant along with Chesapeake had very weak stands after the second year of production.

A Maryland synthetic has been made from superior persistent clones which are the result of 12 years of selection. This synthetic is being compared to other available varieties and breeding lines at Clarksville and Queenstown, Maryland.

Project B-76

Forage Crop Variety Evaluation in Maryland

Twenty-eight varieties of alfalfa were studied at Clarksville and Fairland for forage yields and persistence. The yields for three years indicated that 3 new varieties, Waterman-Loomis 303 and 202 and Pioneer 525, outyielded the standard varieties Williamsburg and Narragansett. At the end of the third year, the stands of the 3 new varieties were similar to those of Williamsburg and superior to those of Narragansett and Dupuits.

The remaining 22 varieties included in the study performed in a similar manner to Narragansett and Williamsburg. The varieties tested included: Cayuga, Glacier, Warrior, Cardinal, Buffalo, Cody, Vernal, Atlantic, Arnim, FD 100, Culver, Haymor, Zia, Ranger, AS13, Cherokee, Caliverde, Moapa, X504, X583, Waterman-Loomis 301 and 304.

Project B-77

Use of Herbicides to Control Weeds in Forages

Chickweed (*Stellaria media*) is a serious winter annual. Chickweed was controlled by postemergence spraying on dormant alfalfa using one-eighth and one-fourth pound per acre of paraquat or diquant, 1 and 2 pound per acre of CIPC, and three quarters and 1 lb. per acre of simazine with no injury to spring growth of established alfalfa.

CIPC formulations impregnated on fertilizer were equally effective as the liquid spray under greenhouse and field conditions.

The herbicidal activity of CIPC is rather slow in manifestation; it takes between 6 to 8 weeks before chickweed is effectively controlled. Simazine's action is very rapid, and weeds are killed within a few days. The killing speed of paraquat and diquat is intermediate.

Project B-79

Late Planting and Winter Survival in Oats

This project was started in 1960 for the purpose of studying late planting as a means of evaluating winter hardiness and other factors that affect winter survival. Seven varieties (Cimarron, Early Wintok, Wintok, LeConte, Dubois, Ballard and Nysel), originally chosen, were grown on the initial site on well drained loam soil near College Park, Maryland.

For the whole period of the project through the harvest in 1967, the following general conclusions seem justified. The varieties used did not differ consistently in winter survival when planted October 1. When all three plantings came through for harvest (4 yrs.) survival averages for varieties were as follows: October 1, 96 percent; October 10, 96 percent; and October 20, 90 percent. In the 1962-63 season, low autumn temperatures caused complete loss of the 3rd planting, limited the second planting to 39 percent and the first planting to 89 percent winter survival.

Average relative yields of grain for the years when all plantings survived were as follows: October 1, 100; October 10, 92; and October 20, 78.

In addition to its effect on yield, delayed planting increased the days to heading date and reduced plant height.

Artificial freezing of plants grown alongside the nursery plots indicated that hardening or resistance to lethal freezing tended to reach the maximum before December 15.

Project B-85

Factors Contributing to Maximum Production in Maryland Tobacco

In 1966, nitrogen rates to 150 pounds per acre significantly increased yields and decreased price per pound of all varieties, with acre return showing no significant gain. Under high nitrogen conditions, Maryland 59 and 609, two newly-released black shank resistant varieties, were superior to Catterton, the standard variety, in yield, price and acre value.

In a second test, no response was obtained from phosphorus added in the fertilizer, even though the soil had a very low level of phosphorus.

Project B-87

Some Physico-Chemical Relationships in Tobacco with Respect to Cultural, Fertilization and Curing Practices

The contents of total nitrogen and total alkaloids were greatly increased in the dry weather crop of 1966. As compared with 1965, a year of normal rainfall, the total nitrogen content was increased by nearly 60 percent and the total alkaloids by 75 percent. A thicker leaf with denser cell structure was noted, also poorer fire-holding capacity and darker, less uniform colors.

Project B-89

The Effects of Physical Characteristics of Herbicides on Efficiency and Mode of Action When Used on Corn and Soybeans

Granular formulations may increase the effectiveness of certain herbicides when compared with spray applications, presumably by reducing losses of the herbicide through volatility, leaching and absorption by clay and organic matter. However, some herbicides are ineffective as granular formulations; apparently the active ingredient is not released sufficiently. Coated mineral base granules were evaluated as a possible means of increasing the spectrum of herbicides which can be applied as granules. The objective was to obtain a slow release of the active ingredient to provide season long weed control.

Sixteen commercially available herbicides were evaluated on over a hundred experimental formulations for both initial and residual activity in the greenhouse using crabgrass as the bioassay. Many of the formulations were about as effective as the commercial spray or granular formulations.

In a field test conducted at the Plant Research Farm, amiben and linuron performed slightly better on mineral base granules than in commercial formulations. Vernolate formulated on mineral base granules performed about the same as the commercial emulsifiable concentrate spray. Both were less effective than the commercial attaclay granules. However, chemical analyses of the mineral base vernolate granules indicated they contained only about one half the specified active ingredient. Possibly the remaining active ingredient was lost during formulation or storage. CIPC was ineffective on mineral base granules in the field study.

Laboratory studies on the rate of release of active ingredient from amiben and linuron granules were conducted in petri dishes. After exposure to moisture filter papers for a specified time, the granules were removed and filter papers were chemically analyzed for active ingredient. Coated mineral base granules of amiben and linuron released about 40 percent to 50 percent of their active ingredient in two days. About 80 percent to 85 percent of amiben and 60 percent to 75 percent of the linuron was released during 8 days.

Project B-94

A Study of the Seed Germination, Rhizome Development, and Control Methods of Johnsongrass

Field studies were conducted to effectively produce soybeans and simultaneously reduce a Johnsongrass infestation.

Basically the experiment was to test the effectiveness of the pre-plant treatments for Johnsongrass control. This method combines dalapon and cultural practices. Johnsongrass is allowed to grow in the spring to about 8-12 inches tall. It is then treated with 7.4 and/or 10 pound per acre of dalapon. One week later the land was plowed, planted, and soybeans planted after three weeks.

A preemergence herbicide was then used for the control of Johnsongrass from seeds.

Dalapon at 10 pound per acre preplow application resulted in no control of seedling Johnsongrass but suppressed rhizome growth 37 percent. In soybeans preplant incorporated application of trifluranlin at 0.75 pound per acre and vernolate at 3.0 pounds per acre resulted in 100 percent seedling control and 7 percent and 70 percent rhizome suppression respectively. Vernolate produced slight injury in soybeans early in the growing season. However, the injury was not visible one month after application and did not affect yields. Combinations of dalapon with either trifluralin or vernolate (applied as above) resulted in 100 percent seedling control and 43 percent and 47 percent rhizome suppression respectively. Soybean yields were increased from approximately 17 bushels per acre in an untreated area to approximately 25 bushel per acre in an area receiving dalapon preplow for rhizone control plus a preplant incorporated herbicide for seedling control.

Additional field experiments concerning application methods were conducted with vernolate. Vernolate was incorporated into the soil with roto tiller, injected in the soil, and swept into the soil in the presence and absence of 10 gallons per acre of a non-phytotoxic oil. One month after herbicide application, seedling control varied from 53-90 percent and rhizome suppression was 53-87 percent. Additions of oil to the soil resulted in a decrease in weed control. *Project B-95*

Almost complete Johnsongrass control was obtained with dalpon and EPTC properly applied.

Investigation of the Agronomic Feasibility of Transplanting Tobacco Seedlings in Pressed Peat-Soil Cubes

The use of pressed peat-soil cubes was very satisfactory in 1967. During periods of average soil moisture, the cubed plants grew-off well without the use of transplant water. However, in times of low soil moisture, transplant water was essential with cubed plants. Uniformity between cubed plants was superior where transplant water was utilized.

A successful hand operated press was developed which turned out peat soil cubes at a rate of over 1,700 per hour and required only one operator.

Project B-96

Hand press developed for one man operation which has a capacity of 1700 cubes per man-hour.

Tobacco plants ready for transplanting that are growing in pressed peat-soil cubes exhibit excellent uniformity.

Red Clover Responds to Good Management

A second location of red clover and red clover-timothy mixtures were harvested at three growth stages at the first harvest. Total yields were similar at all growth stages. This was in contrast to the first study where the early bloom produced the most forage. Chemical analysis indicated little difference in forage quality between the bud and early bloom harvests with the late bloom having lower quality. Spring seedings were superior to fall seedings primarily because of better clover stands. The mixture was superior to clover alone, both in total yield and dependability of stand establishment.

Project B-97

Physiological and Biochemical Mechanisms of Selectivity of Herbicides

Large seeded annual broadleaved weeds, such as morningglory, can be controlled with chloroxuron (Tenoran). Studies were conducted on morningglory (a susceptible species) and soybeans (a tolerant species) in order to better understand the mechanism of selective herbicidal action.

The selective action of chloroxuron (3-(4-chlorophenoxy) — phenyl-l, l-dimethylurea) on soybean (tolerant) and susceptible annual morningglory (*Ipomoea sp.*) was studied using both root and foliar herbicide applications. The following stages of plant growth were used: seed germination, 1, 2, and 3 weeks of age.

Root uptake of radioactive chloroxuron from nutrient culture by soybean was greater than morningglory. Distribution of the radioactivity with the two plant species was very different. Soybean roots contained greater than 90 percent of the radioactivity in the soybean plants, while morningglory roots contained approximately 60 percent of the radioactivity in the morningglory plants. Soybean plants with roots are tolerant to chloroxuron in nutrient solution; however, if the roots are removed and the stem placed in a chloroxuron solution then soybeans become susceptible.

Morningglory foliage contained approximately 8 times more radioactivity than did soybean foliage when ^{14}C-chloroxuron was applied as a foliar spray. The absorption of ^{14}C-chloroxuron by soybean and morningglory leaves (leaves only, no petiol or stem) over a 72 hour period indicated that morningglory absorbs four times the quantity of radioactivity than soybean. No radioactivity was detected in the roots of plants which received foliar ^{14}C-chloroxuron applications.

The amount of radioactivity associated with the chloroplasts (using foliar application) of soybean and morningglory was determined. Morningglory chloroplasts initially contained twice the radioactivity per ug of chlorophyll than did soybean. Upon washing with a small volume of buffer solution, the morningglory chloroplasts contained 5 times the radioactivity than did soybean.

It is suggested that the selective action of chloroxuron, when applied to the roots of these plants, results mainly from differential translocation. The soybean root apparenty provides an effective "barrier" to movement of choroxuron to the above ground portion of the plant. In the case of foliar uptake, differential penetration and affinity of the herbicide for plant components are suggested as important factors involved in this selectivity.

Project B-98

Factors Related to Irrigation of Tobacco

Less than 5 inches of rain fell during the months of June, July and August of 1966, the tobacco growing season. The response to irrigation was spectacular. Yields rose from 1200 to 2100 pounds per acre, price per pound from 42 to 58 cents, and acre value from $500 to $1240.

Increased rates of nitrogen were beneficial with irrigation, the highest yields and acre value being obtained with 120 pounds per acre of nitrogen. Duration of burn, percent nitrate nitrogen, total nitrogen and total alkaloids increased with higher nitrogen rates, but the specific volume, or filling power, of the shredded leaf was decreased.

Project B-99

The Effect of Modified Cultural Practices and Environmental Control of Curing Upon the Adaptability to Mechanization and Quality of Maryland Tobacco

Improved uniformity of cure will be a necessity in future mechanization of tobacco harvesting.

Best uniformity of cured leaf was obtained in the middle harvest dates of 70 to 76 days from transplanting to harvest. This occurred because there was less difference in maturity between the top and bottom leaves at time of cutting. Less than 70 days in the field resulted in immature top leaves with frequent green colors and bottom leaves with very little injury. Periods of over 76 days in the field resulted in more mature top leaves but the lower leaves were overmature and damaged extensively. There was a reduction in the proportion of good bright grades and a corresponding increase in amount of poorer second grades.

Quality as indicated by price per pound remained relatively constant until the last two harvest dates where a decrease occurred. Tobacco yields trended downward after 78 days in the field. The combination of yield and price declines for the last two harvest dates resulted in a markedly reduced dollar value per acre.

Project B-101

Tobacco Breeding, Testing and Quality Evaluation of Maryland Tobacco

Replicated variety trials were conducted at two locations in Southern Maryland to study the responses of varieties and breeding lines to different soil and climatic conditions. Breeding lines with disease resistance were evaluated and compared with the standard varieties

A breeding line (Md. 64-3), derived from a cross of Catterton x Wilson, was released as Md. 64. This new variety is late maturing, high yielding, and resistant to fusarium wilt and black root rot. For the past three years, Md. 64 has produced an average yield per acre of 2,078 pounds with an average price per pound of 59 cents. Burn, aroma and chemical characteristics have been acceptable to both the foreign and domestic tobacco companies.

Maryland 64 is late maturing, high yielding, and resistant to fusarium wilt and black root rot.

Project B-103

Tufcote Bermudagrass — Adaptations and Requirements for Turf Uses

Tufcote bermudagrass (Cynodon dactylon, L.) is a relatively new variety of bermuda adapted for turf uses. In establishment studies with this grass, DMPA and DCPA were successfully used to eliminate weed competition during the first few weeks after planting without injuring newly planted sprigs. Simazine seriously injured or killed all sprigs. Bensulide prevented stolon rooting. Terbutol and benefin were unsatisfactory. In overseeding studies, annual ryegrass seeded annually at 7 or 14 pounds per 1000 sq. ft. into the bermuda turf in the fall produced good turf cover in the fall and early spring. Roughstalk bluegrass was intermediate. Red fescue, tall fescue and Kentucky bluegrass produced poor fall cover in 1966 but grew well in early 1967. All cool-season grasses died

Tufcote bermudagrass stolons without roots in plots treated with bensulfide.

out in 1967 because of close mowing, summer fertilization and competition from the bermuda. Tufcote mowed 2 or 3 times per week at a one-half or 1 inch height was superior to that clipped higher and less frequently.

Project B-104

Management of Kentucky-31 Tall Fescue for Park, Playground and Athletic Field Turf

Machine used to simulate football player traffic on turf. Note football "shoes." Feet are replaceable with golf, baseball or other types shoes.

Tall fescue seed and sod are being used frequently in areas that receive heavy use and moderate maintenance. Seeding rates of 5 and 7 pounds per 1000 sq. ft. are about equal. A three-pound rate is too low. Results from this study indicate that inclusion of Kentucky bluegrass — a non-bunching, cool-season grass— in the mixture improves the overall quality and wear resistance of the turf. Pennlawn red fescue does not blend well with the tall fescue, resulting in poorer turf color and quality than either tall fescue alone or tall fescue-Kentucky bluegrass mixtures. Penncross creeping bentgrass is not compatible with tall fescue. The bentgrass dominates and turns brown in winter and summer months. Extra applications of nitrogen in summer improved turf color, especially at the taller mowing height of two and one-half inches as compared to the one and one-half inch height. Weed invasion was greatly retarded and turf persistence was greater at the taller mowing height.

Project-B-105

Factors Affecting Turf Quality and Rate of Maturity of Bluegrass-Red Fescue Sod

Within a year after planting, differences in turf density and sod quality due to high seeding rate (100 vs. 50 lbs. per acre were no longer evident. Differences in turf color and quality caused by a high nitrogen rate (264 vs. 132 lbs. N per acre per year) were evident only during the first few weeks after application. During summer months, there was no difference caused by the two fall and one early spring application of nitrogen. Sod mowed at three heights varied greatly in resistance to weed invasion. Broadleaf weed counts, made when the turf was 18 months old, showed the following: 42.8 weeds per 100 sq. ft. at the 1-inch height, 2.5 at the 2-inch height and only 0.2 at the 2-inch height. Strips of sod cut from plots mowed at 2 and 3 inches were similar in most comparisons of quality and resistance to breakage. Both were superior to sod which had been mowed at 1 inch. Rhizome growth increased with age of sod in all plots but was greatest at the end of one year in plots mowed at two inches.

Project B-106

Effectiveness and Residual Properties of Several Herbicides Used in Turfgrass Areas

Preemergence control of summer annual grasses, such as crabgrass and goosegrass with herbicides, continues to receive considerable attention, especially as newer herbicides are developed. Herbicides were applied in the spring of 1966 in three geographical regions of the state to study effectiveness of existing herbicides and promising new herbicides. Drought conditions caused them to be only partially successful.

DMPA, DCPA and bensulide continued to give good crabgrass control. Among the newer ones, D-263 was outstanding in annual grass control but caused moderate to severe damage to red fescue in the mixed turf. Benefin was ineffective. SD-11831 gave fair to good preemergence control. M and B-9057 seriously injured or killed existing turfgrasses and had no residual effect on weeds which germinated later in the year. Most of the herbicides thinned the red fesuce in the turf, but had little or no noticeable effect on Kentucky bluegrass. Bensulide and D-263 gave good to excellent goosegrass control.

Bensulide (Betasan, Pre-San) DCPA (Dacthal and DMPA (Zytron) continue to be leading preemergence herbicides for summer annual grasses in turf.

Project B-107

Comparison of Pearl Millet and Sudangrass as Pasture for Dairy Cows

It has been well established that pearl millet sometimes depresses butterfat in dairy cows while sudangrass does not. The conditions under which this depression occurs have been difficult to define. Other work showed that when grown under high soil fertilizer levels of potassium, calcium, and magnesium, pearl millet accumulated higher levels of these cations than did sudangrass. When the plants contained these high levels of cations, their nitrate contents tended to be higher also.

It was decided to see if there was any connection between the cation and nitrate accumulating ability of pearl millet and its butterfat depressing characteristics. With this in mind, pastures were established with both pearl millet and sudangrass at high levels of potassium, calcium, and magnesium, and pearl millet with none of these elements applied.

Cows were fed the forages produced under these conditions, and it was determined that cows consuming the heavily fertilized pearl millet did have their butterfat substantially depressed. On the other hand, cows fed sudangrass or the non-fertilized pearl millet did not experience depressed butterfat. It was also noted that in periods of moderately dry weather the butterfat depression caused by the fertilized pearl millet was more severe. Further work is being conducted to determine the reason for butterfat depression with pearl millet which has been heavily fertilized with potassium, calcium, and magnesium.

Project BG-2

Experimental cows grazing pearl millet. By comparing the performance of cows under grazing and dry lot feeding conditions it was determined that cows respond equally well under both systems.

Harvesting pearl millet to be fed to milking cows as green forage. This method of harvesting and feeding to cows on dry lot permitted more careful measurement of the amount of forage consumed by the cows.

Maximum Potential Yield Studies with Corn Grain, Corn Silage, and Alfalfa

The economic impact of soaring land values, greater mechanization, and more costly labor has emphasized the need for maintaining large dairy herds on relatively small acreages. One method of increasing herd size on a given acreage is to obtain greater productivity from the crops being grown. A study is underway to increase crop yields by use of improved management techniques including higher levels of fertilizer in conjunction with irrigation, and also by use of a double crop system. In the double crop system, corn is grown as silage from May to September and immediately following its harvest, wheat is planted and this is harvested for silage the following May. Results have shown that the crop response to fertilizer is greatest when irrigation is used. The irrigation, however, has proven to be beneficial only for the corn crop. In alfalfa, the irrigation has encouraged weed encroachment and leaf and crown diseases. In three year's time, irrigation has practically eliminated a stand of alfalfa. The greatest response to irrigation on the other hand, has been with the double crop system. Here, the wheat silage has yielded three tons per acre of dry matter and the subsequent corn silage crop has produced ten tons of dry matter. This thirteen tons per acre of dry matter may be compared to a total of ten tons of corn plus wheat under non-irrigated conditions or eleven tons of corn silage as a single crop under irrigation.

Project BG-3

Research plots showing overhead irrigation. Plots of tall corn in the background were planted in early May. Corn plot in the foreground was planted in late May following the removal of a wheat crop as silage. The photo was taken in Mid-June.

Development of Improved Strains of Maryland Tobacco Resistant to Disease

At the present time, tobacco mosaic appears to be the most destructive disease in the production of Maryland tobacco. Resistance to tobacco mosaic has been found in *Nicotiana glutinosa,* a wild relative of cultivated tobacco, and is presently being incorporated into several Maryland varieties and breeding lines.

Black shank resistance from Md. 59 and Md. 609 also is being incorporated into new breeding lines along with mosaic resistance. Combining the high quality and black shank resistance of Md. 59 and Md. 609 with mosaic resistance and high yielding ability of certain superior breeding lines should produce a very desirable variety.

Project J-95

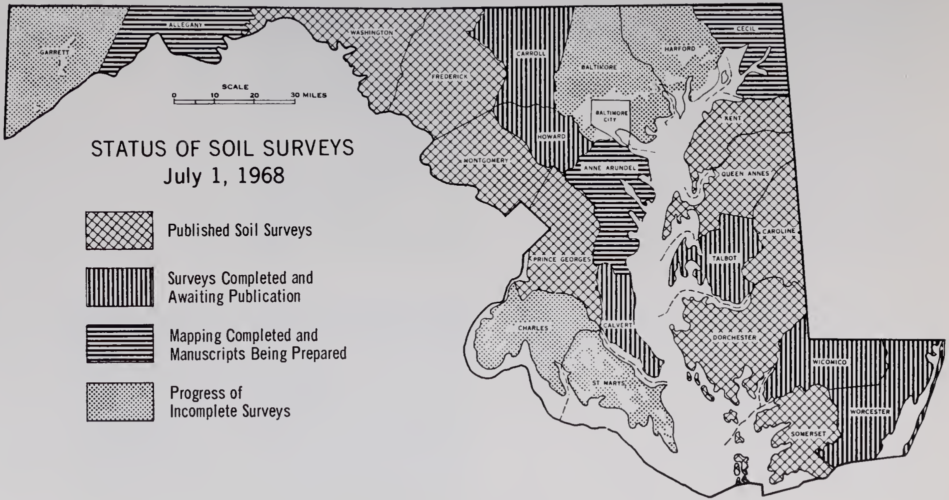
The Soil Survey Program in Maryland

A key requirement in the wise use of our soils, whether for agricultural or non-agricultural purposes, is an inventory to determine the amount, quality, potential uses, and management requirements of this resource. In response to this need, an inventory of soils in the United States was initiated in 1899 by cooperating federal and state agencies. As a part of this national program, the Soil Conservation Service, USDA and the Agricultural Experiment Station are currently involved in a soil survey of Maryland. The map shows the status of this program. Approximately 97 percent of the state has been mapped by the Soil Conservation Service, and 9 county soil survey reports have been published. These reports have proven to be an extremely valuable guide in farm planning, urban development, highway and pipeline construction, tax assessment, and many other uses.

The role of the Experiment Station in this program is: (1) cooperating in reviewing the manuscripts and publishing the county soil survey reports; (2) providing field assistance in correlating soil mapping units; and (3) supplying laboratory data to aid in the classification and interpretation of soil units. With the field survey program in an advanced stage, current emphasis is being placed on the laboratory characterization of the chemical, physical and mineralogical properties of the major soils in Maryland. Sixty soil profiles, representative of Maryland's most extensively occurring soils, were sampled in 1966 for complete laboratory analyses. Data obtained from this study will provide basic information useful in proper land management.

Project O-48

MARYLAND



Map showing status of soil survey program in Maryland
(Map prepared by Soil Conservation Service).

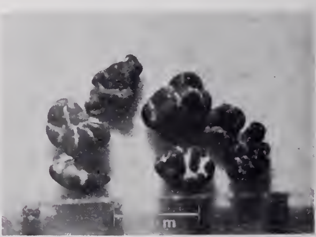
USDA-SCS-HYATTSVILLE, MD. 1968

Clay Mineralogy of Maryland Soils

Maryland's greensand soils, which occur in a belt between Washington, DC. and Annapolis, Maryland, are developed in parent material composed predominantly of sand-size quartz and glauconite pellets. Soils developed in these sediments are classified mainly in the Collington and Monmouth soil series. Much of the clay separated from these soils for study, existed in the field in the glauconite pellets. X-ray diffraction patterns prepared for pellets of different shapes (lobate vs. vermiform) showed them to be composed of the same minerals. The main mineral present was glauconite, thus the term glauconite pellet is an appropriate one. Glauconite is a micaceous silicate mineral containing considerable potassium and iron. The potassium may be released during weathering. However, since most of the glauconite is found to be weathered out of the surface horizons of these soils, crops grown on these soils still require some potassium fertilization. Iron released during weathering apparently goes into the formation of the iron concretions and pans that are common in many of these soils. Studies of these soils are instructive because they show the occurrence of clay minerals in sand-size particles. Similar situations are also being observed in some other soils.

Project O-54

Photomicrograph of glauconite pellets, mainly of the vermiform type. Glauconite forms under marine conditions. Vermiform pellets may represent mica grains that were transformed into glauconite.



Photomicrograph of glauconite pellets of the lobate type. Lobate pellets may represent fecal pellets that were transformed into glauconite by marine metamorphism.

Liming Maryland Soils

Liming studies show time after time that this practice needs more attention in Maryland. In view of this, liming should continue to receive attention. The supposition of many researchers that limestone particles react at a constant rate in soils is not always true. Maryland research shows that when a limestone particle lies undisturbed in the soil, it fails to react at a constant rate. In fact, the reaction rate may decrease five fold in five to ten days.

Other findings show that when a

limestone of mixed composition (calcite and dolomite) is separated by screening, the amount of calcite and dolomite, in the different sizes is not constant. In fact, it may vary 2 to 3 fold.

Project O-55

Effective Use of Soil Nitrogen

Plowing down nitrogen as urea in the fall for Red Coat wheat resulted in a 3 to 5 bu. increase over a spring treatment. This was observed at two locations. A third experiment showed no difference to plowed down urea in the fall or surface applied in early spring. These experiments were conducted under conditions where the rainfall was low during the winter months.

Wheat tests of a height reducing hormone and nitrogen topdressing showed that the hormone increased yields approximately 4 bu. per acre when 60 or 90 pounds of nitrogen were topdressed and yields were reduced about 3 bu. per acre when 120 pounds of N. was used.

Project O-57

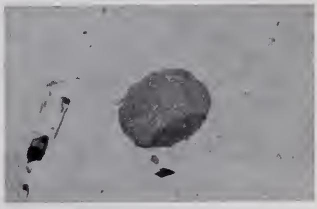
Nutrient Levels in Corn Grown on Maryland Soils

A study of the nutrients in knee-high corn indicated that 48 percent of the samples contained very high levels of copper. On the other hand, the concentration of magnesium, calcium, phosphorus, and potassium in these tissue samples were often low. Of all the samples, 10 percent were below the critical level in phospshorus, 13 percent in potassium, 15 percent in magnesium. Corn fertilized with 0.5 pounds of boron per acre failed to give a response to the treatment under drought conditions which limited yields to about 40 bu. per acre.

Project O-62

Effect of Nitrogen, Phosphorous, and Potassium on the Growth and Development of Forage

Alfalfa is an important source of forage in Maryland. But, to compete successfully with other crops, stand longevity is important. Diseases and winter-killing are responsible for the loss of many poorly managed alfalfa stands each year. To learn more about how potassium fertilization can help alfalfa plants to resist disease injury and winter killing, plants were grown in the greenhouse under various levels of phosphorus and potassium fertilization. Top and root



Phosphorus or potassium deficiency resulted in very poor root development characterized by smaller root diameter, smaller xylem vessel diameter, and fewer xylem vessels per root.

yields, phosphorus and potassium content and xylem vessel diameter, root diameter, and number of xylem vessels per root were determined. Phosphorus and potassium tended to increase root size, xylem vessel diameter, and number of xylem vessels per root. It is theorized that these changes in root anatomy can result in a more winter hardy and disease resistant plant. Adequate phosphorus and potassium fertilization is essential to successful long-term management of alfalfa stands.

Project O-64

Adequate phosphorus and potassium resulted in larger root diameter, larger xylem vessels, and more xylem vessels per root.

Nutrient Balance in Orchardgrass as Related to Differential Fertilization

Orchardgrass was grown under several rates of phosphorus, potassium, and magnesium fertilization in an effort to learn more about the effect of nutrient balance on forage yields. Due to the dry weather, yields were limited in 1966 and averaged about 3.7 tons of dry matter per acre. Despite the dry weather, phosphorus and potassium fertilization increased yields significantly. With just 20 pounds per acre of P (46 pounds per acre P_2O_5) yields were increased from 2.8 to 3.9 tons per acre for the 4 cuttings. Additional increments of phosphorus did not further increase yields significantly. Yield increases from phosphorus and potassium were greatest in the first cutting when moisture was not limiting and in the last cutting after fertility levels had been depleted in the lower treatments. Yield responses were closely related to soil test levels in all cases. No response was obtained to magnesium fertilization and this was not unexpected since soil tests indicated 30 to 40 pounds per acre of weak acid extractable magnesium present.

Project O-71

Soil Aeration and Crop Growth

Oxygen and carbon dioxide content of soil air samples taken from plots in waste disposal irrigation areas of processing plants in July 1967 indicate that important farm crops can grow in soils with carbon dioxide concentrations that are far above what has been considered harmful by most investigators. Measurements made at Cordova, Maryland in the tall fescue grass plots showed a CO_2 content of 7.5 percent and samples from reed canary grass fields at Chestertown had 13 percent CO_2. Corn appeared to be thriving at Ridgely with 7.5 percent CO_2 in the soil air. The lowest oxygen content was 8 percent in the soil air samples from reed canary grass. The CO_2 concentrations found were much higher and the oxygen concentrations were much lower than air samples that had been taken from research plots that were not under waste disposal irrigation. It appears likely that soil aeration is mainly a problem only in flooded soils.

Project O-72

Nutrient Requirements of Summer Annuals for Forages

The fertilization of a commercially available sudan-sorghum variety was studied to learn the most efficient way to produce maximum forages during the dry summer months when bluegrass pastures are normally dormant. The summer annual was grown under various levels of phosphorus, potassium, and nitrogen. Despite the severe drought during the 1966 growing season, the grass was harvested once in July and once in late August for an average of two and a half tons per acre of dry matter. No differences occurred due to the fertilizer treatment. Water was a more severly limiting factor than fertilizer. Nevertheless, the summer annuals produced a respectable yield under conditions where the growth of other forage plants was at a minimum .

Project O-73

Response of Corn to Fall vs. Spring Plowing, Broadcast vs. Plow-down Fertilizer, and Fall vs. Spring Fertilization

In an effort to utilize time, labor, capital, and machinery more efficiently, many farmers and members of the fertilizer industry are becoming increasingly interested in plowing down a complete fertilizer in the fall for corn the following spring. Corn tests were conducted at five locations in Maryland. A complete fertilizer containing nitrogen as urea, ammonium sulfate, ammonium nitrate, or nitrate of soda was either plowed down in the fall or plowed down or disked in the spring. The 1966 growing season was so dry that yields were severely limited at all locations and no differences between treatments were observed. Under normal rainfall conditions, nitrogen leaching losses might have been excessive and cost farmers thousands of dollars annually. This project is being continued in anticipation of more normal growing conditions and subsequent plant response in future years.

Project O-75

A Study of the Use of Measurements for the Evaluation of Beef Breeding Stock

Work on the final analyses of the data of this project is progressing at a satisfactory rate. One bulletin describing the places measured on the steers, the instruments used, the points measured, the means, standard deviations, and coefficients of variation of the measurements for both the 900 pound and 1000 pound steers has been published. A second publication deals with the effects of large ranges in the live weights of steers on the evaluation of the useability of measurements for predicting the weights of wholesale cuts of carcasses from measurements taken on the animals before slaughter. Large ranges in live weight were found to mask the effectiveness of using measurements and a statistical procedure to eliminate this masking effect was formulated.

Project C-40

ANIMAL SCIENCE

The Department of Animal Science serves producers and other members of the livestock industry, as well as consumers, by doing research in the fields of breeding, feeding, nutrition, and management with the primary objective of trying to find new or improved methods for producing better livestock more economically. Beef cattle, sheep, and swine are the animals with which the researchers work.

As rapidly as new information is found and verified, it is published in scientific journals, technical bulletins and/or popular publications. A continous effort is made to bring new information to producers and other portions of the population in clear, understandable terms as quickly as possible. Technical and other information is incorporated into classroom material for both undergraduate and graduate students and also made available to Extension service personnel.

BREEDING

Beef Cattle

Analysis of Records of Beef Cattle Herds in Maryland

Individual feeding of animals, taking measurements, and analyses of data have been the main activities on this project during the past year. A total of 46 bull and heifer calves were born in the research herd and 43 bull and 55 heifer calves were born in the herd of the cooperating breeder, Wye Plantation, Queenstown, Maryland. Forty-six bull calves in the research herd completed their feed-gain trials during the year. They averaged 585 pounds at 225 days of age, 1009 pounds at 365 days of age, and a 3.03 pound gain per day while on the 140 day trials. The 30 heifers which completed feed-gain trials averaged 521 pounds at 225 days of age. Twenty-seven which came off trial at 337 days of age averaged 751 pounds and had an average daily gain of 2.13 pounds. Three females grew so rapidly that they were removed from trial when only 309 days of age. They averaged 789 pounds and gained 2.3 pounds per day while on trial. In addition, 37 bulls and 29 heifer calves were started on feed-gain trials.

Extensive preliminary analyses of the data available on all animals (over 2,500) were initiated. The types of analyses conducted included correction factors for years, season of birth, age of dam, and sex. Covariates—including inbreeding of the sire, dam, and calf where applicable, and weaning age—were used. The type of data analyzed included weaning weight, weight at the end of each 28-day period of the feeding period as well as total digestible nutrients (TDN) per 28-day period, gain and average weight per 28 day period, and TDN per pound gain and TDN per pound average weight per period. Results of these preliminary analyses have been organized but additional analyses will have to be made prior to publication of the results.

Project C-39

Study of Variations in Value of Criteria Used in Selection Indices for Beef Cattle

The research program involving the University's herds will continue to emphasize at least two main phases: (1) the application of presently confirmed, sound methods of selection for efficient, acceptable cattle, and (2) the gathering of additional kinds of data in a search for better methods for evaluating beef animals. Basically, cattle should gain rapidly and economically; produce high quality, meaty carcasses; and have a fully acceptable conformation both when alive and in carcass form. At the present time only two criteria can be compared with similar criteria available on the cow herds at the start of this project. These two criteria are: adjusted 205-day weights and 365-day weights. The progeny of the present herd sires have made progress in some but not all criteria. The adjusted 205-day weight for the Angus showed a small increase of 11 pounds for heifers and 4 pounds for steers. Hereford showed a 33 pounds decrease for heifers and 41 pounds for steers. For the 365-day weight the Angus increased 24 pounds for heifers and 31 pounds for steers; Hereford increased 56 pounds for heifers and 11 pounds for steers. Since both of the herd sires are ton bulls, it would appear that sires are having more influence on yearling weights. Replacement heifers, by the present herd sires, are now coming into production. Carcass data being collected would seem to indicate that improvement in carcass quality is being made with less external finish. This is holding true for both breeds. Progress will be slow due to the small number of breeding females in each herd. Also due to lack of numbers, some females are being added to the herd that otherwise would not be suitable replacement stock

Project C-41

NUTRITION

Sheep

The Effects of Roughage Preparation

One of the major problems of poor quality roughages is that they are so unpalatable or so poorly balanced nutritionally, they are not consumed in quantities sufficient to provide energy for maintenance or useful function in ruminant animals. A variety of materials which may be available, incidental to the production of vegetables or grains, are classable as low quality forages and are not now economically utilized. One interesting possibility is that certain low value forages could be combined to make mixtures which would be more useful as livestock feeds than would any one of the forages alone. For example, high moisture alfalfa silage is not so acceptable to sheep or cattle as wilted silage or air dry forage; unsupplemented, ground corn cobs are practically useless as a feed. Ensiling high moisture alfalfa with ground corn cobs, however, will produce a palatable silage and utilize the cobs.

Studies designed to investigate the possibilities of mixing dry, low quality forages with tomato vines or other tomato wastes have been initiated. A series of silages made from green tomato vines, ripe and green tomato fruits added to dry forages or from wilted tomato vines has been prepared and will be fed to growing lambs. Palatability trials with sheep indicate that the animals will consume appreciable quantities of ensiled tomato vines and that the high moisture tomato fruits may make a useful feed when mixed with ground corn cobs. Dry matter consumption of the mixtures was considerably higher than that for either the tomatoes or cobs alone. Analyses of tomato products ensiled for 30 or 60 days indicate volatile acid and total acids contents consistent with hay crop silages. Nitrogen contents of both fruits and vines were high enough to suggest the materials would be useful in supplementing low protein forages.

High moisture (direct cut) alfalfa or Sudan grass-sorghum forages were ensiled *per se* or mixed in a ratio of 4:1 by weight with ground corn cobs to reduce moisture and then were ensiled. Similar forages were ensiled after wilting or were field cured as hays. Preliminary short time palatability studies indicated that the wilted alfalfa silage is more palatable to sheep than the direct cut silage, but a similar difference was not observed with the Sudan grass-sorghum silages. Feeding trials with the ensiled and cured forages have been initiated. Detailed chemical analyses of the silages are also being made in an effort to elucidate reasons for the apparent superiority of wilted silages or air dried forages over forages ensiled with high moisture contents.

Project C-25a

A Study of Rates of Ruminal Digestion and Absorption from the Rumen

The effects of restricted energy intake on the growth rates of young animals have been demonstrated many times. Designs of feed or energy restriction studies, especially those with meat animals, have often restricted protein and/or other nutrients as well as energy. An experiment has been conducted to study the effects of an intermittent feed restriction pattern on weight gains and feed efficiencies in growing and finishing lambs. A treatment was also included to allow 87 percent of the *ad libitum* consumption. Forty-eight lambs were divided into 6 equal groups on the basis of weight and sex and were assigned to six different treatments. Group 1 was allowed *ad libitum* consumption of a diet containing 60 percent ground corn, 3 percent SBOM, 30 percent alfalfa meal and 7 percent molasses. Group 2 was allowed 87 percent by weight of the *ad libitum* TDN calculated consumption with a diet containing 55 percent corn, 8 percent SBOM, 30 percent alfalfa meal and 7 percent molasses. Groups 3, 4, 5, and 6 were allowed *ad libitum* consumption or TDN consumption required for maintenance alternated as follows: 6 days—3 days, 6 days—6 days, 10 days—5 days, 10 days—10 days, respectively. Such periods for *ad libitum* and restricted consumptions were selected arbitrarily and the same diet as for group 2 was fed to all four groups. The actual TDN consumptions for the treatment groups 2, 3, 4, 5, and 6, as percentages of *ad libitum* consumptions were 88, 89, 73, 84, and 74, respectively. Crude protein intakes averaged 103, 104, 92, 98, and 93 percents of group 1 intake for groups 2, 3, 4, 5, and 6, respectively. Results also indicate that restricting the feed consumption to 84 percent of the *ad libitum* consumption in an intermittent feeding pattern and by continuous restriction to 88 percent of the *ad libitum* consumption did not much alter the feed efficiency though average daily gain was reduced.

Ruminal ingesta samples of animals restricted to 88 percent of the *ad libitum* energy consumption and compared to controls showed significantly higher proportions of acetate and lower proportions of propionate. Such lambs also had lower concentrations of blood glucose as compared to those of the control lambs. In the intermittent feeding regimes reported here, no significant differences were observed in the molar proportions of the VFA in the rumen and glucose concentrations in blood between the control and intermittently fed animals, when sampled during the *ad libitum* feeding priods. However, the differences in these parameters between maintenance and *ad libitum* periods within each treatment were significant. In the animals on the alternated regimes, there were higher proportions of acetate and lower proportions of propionate in the rumina and lower concentrations of glucose in the blood for half or one-third of the experimental period. In lambs restricted to maintenance for one-third of the feeding period, feed conversion was not much altered and carcasses comparable to those of the control group were produced.

In other studies, an adipokinetic substance was isolated from the urine of fasting sheep. Assay for the active substance indicated that it had a molecular size smaller than cresolsulphonphthalein (MW equal 382). The active fraction was positive to the potassium ferricyanide-formic acid test for epinephrine and was fluorescent in the presence of ammonia. No activity of a molecular size large enough to be a peptide could be isolated. The injection of growth hormone (GH) elicited an adipokinetic response in the intact dog. Partial pancreatectomy, after which the blood circulation to the pylorus and duodenum remained intact, did not abolish the adipokinetic response to GH. However, disrupting the circulation to remaining pancreas, duodenum and stomach in partially depancreatized or normal dogs did eliminate the adipokinetic response to GH. It appears that GH is not significantly adipokinetic due to its own direct action on adipose tissue but it acts via a tropic action upon hormone (s) located in the pancreas, duodenum, or stomach.

Project C-42

Procurement and Study of the Gnotobiotic Ruminant

Existence of the functional rumen, the large "paunch" or "fermentation vat" with its populations of microorganisms which contribute to the nutritional economy of the ruminant, is the primary feature which necessitates a distinction between ruminant and non-ruminant nutrition. Few mammals can approach the complex symbiotic relationship achieved by the ruminant and its large microbial population in the rumen. Isolation of the ruminant from its normal microbial population affords a unique opportunity to separate environmental influences from innate metabolism. Development and histology of the ruminant digestive tract is known to be affected by microbial function and could be more precisely studied through observations on gnotobiotic or "germ-free" ruminants. The gnotobiotic animal also would offer an opportunity to clarify functions of specific strains of micro-organisms as known; controlled populations can be introduced into the animal. In direct or indirect calorimetry on the "whole animal," the heat of fermentation which represents an energy loss before nutrient absorption cannot be separated from heat increment which should represent energy cost incidental to absorption and utilization of "truly digestible" nutrients. Calorimetry on gnotobiotic lambs and on similarly fed lambs with normal rumen function should allow separation of pre-absorptive and post-absorptive heat production and thus more clearly define the usefulness of digestible energy as a measure of productive energy, providing evidence as to the efficiency of ruminant metabolism when it can be separated from the energy cost of rumen function. These considerations have led to the initiation of studies on gnotobiotic lambs reared in plastic isolators.

To date, six lambs (four taken by caesarean section in a surgical isolator and two taken by hysterectomy with the excised uteri passed through a bactericidal bath), have been started. The "germ-free" condition has not been kept patent for more than seven weeks with any lamb. Control lambs fed the sterilized semi-synthetic diet in the isolators or fed pelleted corn-alfalfa diets in addition to milk for 4-5 weeks have been reared in cages. The seven week old lamb was sacrificed when microbial contamination was detected in the isolator; the digestive tract was compared to those of similar age control animals. Weight of the excised rumen of the lamb, which had been "germ-free," was about 30 percent of that of either control. Papillary development was negligible and the rumen wall was much thinner than those in the controls. The control lamb fed the sterilized diet exhibited the large papillae and the melanistic parakeratosis associated with the feeding of all concentrate diets to ruminants. The digestive tract of the lamb fed the corn-alfalfa pellets was typical of the animal with a normal functional rumen. These observations suggest that the parakeratosis that occurs in concentrate fed ruminants is due to microbial activity or an interaction between organisms and diet and not to diet *per se*. Lambs gained about 16 pounds each in seven weeks and the "germ-free" lamb grew at a rate similar to the controls. Growth rates were less than those expected of nursing lambs, but consistent with those observed in lambs bottle fed from birth. Some difficulty was experienced with caramelization and vitamin destruction in the sterilized diets and techniques to correct this are being investigated.

Project C-43

Swine

The Effect of Menhaden Fish Meal on the Quality of Protein of Swine Diets

Investigations have been completed to relate the causal agents within fish oil to the fishy flavor in animal tissue when this oil is a part of fish meal in the diet. These investigations have led to the hypothesis that certain long-chain polyunsaturated fatty acids commonly found in fish oil are the precursors of the flavor-producing components.

Menhaden fish oil was included in diets to represent various levels that would occur in diets supplemented with fish meal. Some animals were continued on these treatments until they were slaughtered at the weight of 200 pounds. In two other groups, the fish oil was withdrawn when the animals reached 150 or 175 pounds. Fatty acid analyses were made on samples of liver, fat, and muscle tissue. Samples of meat from the loin of each experimental animal were also subjected to a taste panel evaluation to detect the presence of fishy flavor.

When a level of fish oil between 0.8 percent and 1.2 percent was included in the diet, there was a significant correlation between the long-chain polyunsaturated fatty acids in the tissue and the detection of fishy flavor. These correlations were not observed at lower feeding levels or when the oil at any feeding level was withdrawn at 150 or 175 pounds.

Project C-33

Early Protein Intake and Carcass Quality

Research has been continued on the comparison of various natural sources of protein in the diet of the young pig. Carcass quality at slaughter weight has been used as one basis to evaluate the adequacy of early protein nutrition. Rate of gain and feed efficiency were also observed.

Our primary question has been an evaluation of the adequacy of amino acid balance in soybean oil meal to support rapid muscle tissue development in the young pig. First, it must be determined whether the quality of protein in soybean oil meal does restrict muscle development in the young pig. Secondly, this restriction must be large enough to make a significant difference in the quality of carcasses produced when the animals are slaughtered at the weight of 200-210 pounds.

Preliminary observations have indicated that soybean oil meal protein is not deposited as muscle tissue as efficiently in the 3 to 5 week old pig as protein from dried skim milk and fish meal is. This was determined by comparing diets containing soybean oil meal as the major protein source with those containing dried skim milk and fish meal. This conclusion is based on chemical analyses of carcass composition and nitrogen balance technique. The difference between nitrogen intake in the feed and that eliminated in feces and urine represents the amount of nitrogen deposited as protein in body tissue. Nitrogen balance and carcass composition have both indicated markedly lower levels of protein efficiency for pigs fed only corn and soybean oil meal protein. These differences occurred between the ages of 3 to 6 weeks and then gradually disappeared, until no differences were observed at 10 weeks of age

Similar dietary treatments seem to have variable influence on subsequent growth. These include differences in growth rate, compensatory growth, age at slaughter, and gross carcass measurement at 200 pounds. The choice of utilizing more costly, high quality protein diets is dependent upon two factors: (1) rate of growth, if it has an economic bearing on utilization of feeding facilities and (2) the market value of 200 pound hogs with varying degrees of carcass merit. The data assembled now do not economically justify feeding higher quality protein to young pigs unless superior carcasses can be sold at a premium, and a 10-day shorter feeding period permits greater utilization of facilities.

Projects C-35 and C-38

PHYSIOLOGY

Swine

Basic Studies in Swine Reproduction

Reproductive efficiency of sows, as measured by litter size, is quite variable. Investigations of this variability as influenced by ovarian function have been continued. Recommendations on nutritional and management procedures remain hazardous due to incomplete understanding of the basic physiology controlling ovulation rate and the maintenance of pregnancy.

Data developed during the past year indicate that ovulation rate might be increased by reducing the level of progesterone secretion during the estrous cycle. This was demonstrated by surgically removing portions of the ovarian components, the corpora lutea, which secrete the hormone progesterone. Progesterone secretion by the ovary normally inhibits secretion of the follicle-stimulating hormone by the master gland, the pituitary gland.

It has been known that injections of a follicle-stimulating horomone will increase follicle development and ovulation rate. However, this has limited practical significance because of the requirement for injection and the narrow range of effective dose for individual animals. The surgical methods employed in these experiments are equally impractical. On the other hand, progesterone is less complex chemically than a follice-stimulating hormone. This leads to speculation that a chemical antagonist might be developed to partially limit the effective level of a circulating hormone. Materials of this nature may be administered routinely in the feed.

Project C-34

BOTANY

The Native Plants of Maryland

The study of our natural vegetation continues.

Numerous identifications of plant specimens, including trees, weeds, and poisonous plants were made for the rural and urban residents of Maryland and the Extension Service; this involved both cultivated and natural plants. One unique case involved determination of the age of a human skeleton found in an Eastern Shore marsh.

The study of Sand Spits, their vegetation, and changes over the past century was completed. Collections and field studies in Howard and Calvert counties and Assateague Island are completed. Stations were found for several species previously unknown for Maryland.

Project F-12

Genetic Control of the First Division Association of Homologus Chromosomes and Fertility in *Zea mays* and *Capsicum Frutescens*

Chromosomal structure is quite clear in corn following synapsis or pairing of like chromosomes in the pollen mother cells. Each of the ten pairs can be identified permitting correlated genetical and chromosomal studies. In contrast, the earlier prepairing stages have not been studied extensively. Pollen mother cells for chromosomal analysis are obtained by dissection of the immature tassel from the stalk. Young tassels were collected from inbred KYS at an earlier time than is customary. Observations of this material disclosed that prepairing stages were present in anthers approximately one millimeter in length. Information will be obtained on the movement of like chromosomes prior to full pairing since chromosomal association is required for fertility.

Project F-18

Effect of Fungicides on Cellular Metabolism and Vegetable Diseases

Two new organic compounds tested show promise as systemic fungicides in plants. An oxathiin derivative (Plantvax) applied to the seed gave excellent control of bean rust. Chloroneb applied to Virginia pine or bean seeds gave good control of *Rhizoctonia* root and stem rot. Studies of the mode of action of these toxicants indicate they may selectively inhibit nucleic acid metabolism in sensitive fungi.

Project J-91

Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases

Indexing species of Medicago and varieties of alfalfa has continued. The selections from *Medicago sativa* var. *gaetula, M. sativa* cv Narragansett and Williamsburg, *M. arabica, M. polymorpha M. tianschanica* and *M. lupulina,* still show highest resistance to Sclerotinia root and crown rot. Seed from clones and crosses of the above plants have been collected and will be indexed during the 1967-1968 winter.

Project J-93

Resistance to Sclerotinia root and crown not in species of Medicago: 1. M. falcata and 2. M. tornata susceptible; 3. M. lupulina, 4. M. sativa var. Williamsburg and 5. M. sativa var. varia showing resistance to Sclerotinia.

Physiology and Biochemistry of Nematodes and Nematode-Host Relationships

Identification and metabolism of sterols were studied in the vinegar eelworm, *Turbatrix aceti*, in relation to nutritional requirements of nematodes. The major sterols in this nematode are cholesterol and 7-dehydrocholesterol which occurred in about equal quantities, and accounted for about 0.03 percent of the dry weight of nematodes. Using radioactive intermediates it was found that *T. aceti* could not manufacture sterols from simple precursors. Using radioactive sterols it was determined that this nematode could make 7-dehydrocholesterol from cholesterol, and it could metabolize two plant sterols to make nematode sterols. Thus, it appears that nematodes obtain sterols from dietary sources and transform them to nematode sterols in nature. It may be possible to exploit this requirement for sterols to develop new and better methods for controlling nematodes of economic importance.

Project J-97

Development of Improved Strains of Maryland Tobacco Resistant to Diseases

Testing Maryland tobacco varieties for resistance to tobacco mosaic and black shank showed some loss of resistance to black shank. The crosses, Md 59 X (Md 59 X 41-2) X Md 59 and (Catterton X 41-2) X (Md 59 X 139C), for duo resistance to black shank and TMV in the F_3 lost resistance to black shank but did not lose resistance to TMV. The crosses (609 X 41-2) X 609 and 609 X 41-2 did not lose resistance to either disease. It will probably be necessary to backcross the first two above to Md 59 to increase the black shank resistance. Plant characteristics of Md 59 and Md 609 appear to be dominant in the crosses listed above. The Md 59 X Catterton cross in the F_6 has stabilized plant characteristics and also has retained high black shank resistance.

Tobacco variety with characteristics similar to Md. 609 has resistance to black shank and tobacco mosaic.

Project J-95

Identification, Characterization and Control of Certain Viruses Affecting Economic Plants in Maryland

When southern bean mosaic virus (SBMV) is treated with ethylenediamine tetracetic (EDTA) acid and ribonuclease, nucleic acid breakdown products are released. The EDTA apparently changes the virus structure, permitting ribonuclease to enter the virus particle and cleave the ribonucleic acid polymer. These studies suggest that divalent metal ions may be necessary for maintenance of the SBMV virus structure and that one possible mechanism by which infectious nucleic acid is released in plant cells is by removal of metal ions from the virus particle.

Project J-98

The Nature and Control of Diseases of Ornamentals and Turf Grasses in Maryland

One of the most successful mycoparasites is the fungus *Darluca filum* which attacks and destroys the rust fungi without having any effect on the host plant. Studies on this organism have been limited due to the difficulty of growing it in culture. We have succeeded in growing Darluca on a chemically defined medium which should enable us to determine: 1) why it attacks only the rust fungus, and 2) the influence of nutrition and environmental factors on its development. Eventually we hope to be able to control the rust fungi either directly by inoculation with Darluca, or indirectly by application of metabolites obtained from Darluca.

Fusarium roseum continues to be a serious pathogen of turfgrasses. A study of the influence of environmental factors on its development in the laboratory will aid in controlling this fungus in the field. *Fusarium roseum* appears only after temperatures in excess of 90 degree F; however, the fungus grows poorly at these temperatures in the laboratory, indicating that factors other than temperatures are important in its development. Although Fusarium can be prevented by repeated fungicide applications, we eventually hope to be able to control it by cultural means.

Project J-99

Forest Tree Seedlings and Soil Fungi Relationships

Root diseases are not a serious problem in the State Tree Nursery at Harmans, Maryland even though soil fungicides are not used. In a nearby tree nursery, however, root diseases are a recurring problem even though soil fungicides are regularly used. Soil samples were taken from both nurseries and many more saprophytic fungi were isolated from the nontreated than from the fungicide treated soil. Two of the most common soil saprophytes, *Penicillium* sp. and *Aspergillus niger,* were isolated into pure culture and were used in further tests.

Virginia pine seeds were surface sterilized with 30 percent hydrogen peroxide and germinated on corn meal agar in petri dishes. When the plants were 10-12 days old, the roots were placed on the surface of established agarcultures of the root rot fungi , *Phythium debaryanum, Phytophthora cinnamoni* or *Rhizoctonia solani.* The pine roots were completely rotted within 120-140 hours after being inoculated. When similar roots were placed on cultures of either saprophytic fungus for 3-5 days before inoculation with the pathogens, rotting of the roots was delayed an average of 40 hours.

The saprophytic fungi slightly inhibited growth of the pathogens *in vitro* and so, in other experiments, the saprophytes growing on the roots were killed by rinsing the roots in 31 percent hydrogen peroxide or 95 percent alcohol for 30-45 seconds before inoculating with the pathogens. The same delays in attack by the pathogens were present on roots in which the saprophytes had been killed, indicating that simple antagonism was not responsible for the delay in infection.

Project J-101

Maximal Growth and Yield of Snapbeans and Soybeans

In automatically-irrigated hydroponics cultures in the greenhouse, in which many limiting factors could be overcome, plant growth and yield apparently approaching maxima have been obtained. In some treatments, Encore snapbean yields exceeded one pound of beans per plant. As the N level in the nutrient solution was increased, the level of K in the leaves increased, Ca decreased, and Mg was unaffected. Phosphorus had no effect on the levels of K, Ca, or Mg in the leaves. As S was increased, there were no effects on K or Mg in the leaves, but Ca decreased.

In a cation experiment with Dare soybeans, yields increased from low to medium to high Ca (439, 526, and 553 pods per plant). Similarly, but more strikingly, with K the yields increased from low to high (386, 542, 629). Mg level had no significant effect on yield of pods. Some of the soybean plants were 10 feet tall and, for the entire experiment, the yields averaged over 500 pods per plant. When completed, an attempt will be made to interpret the soybean yields in terms of leaf analyses.

Project K-8-*c*

Regulation of Protein and Nucleic Biosynthetic Processes in Plant Tissue

Deoxyribonucleic acid (DNA) contains the genetic information on how to build and operate a plant cell. The information is encoded into the chemical composition of this long linear polymer. In order for a cell to read and thus utilize this information for the manufacture of cellular components, a complementary copy of the information must be synthesized. The complementary copy of the DNA is ribonucleic acid (RNA). DNA occurs naturally as a double helix of two complementary strands.

We have asked the following question: At the time of translation (making a complementary strand of RNA), does a corn cell use double stranded DNA as a source of genetic information (template)?

To answer the question, we have isolated and partially purified an enzyme called RNA ploymerase from five-day-old corn seedlings. This enzyme requires DNA to synthesize RNA from low molecular weight chemicals. We have been able to experimentally demonstrate that single stranded DNA is a far better template than double stranded DNA for the synthesis of a complementary strand of RNA. Corn seedlings grown in the light, carry out this translation process more efficiently than do corn seedlings grown in the dark.

Project K-9

The Effect of Culture Temperament on the Content of Unsaturated Fatty Acids in *Chlorella*

Chlorella sorokiniana was grown in the dark at seven different temperatures: 38, 34, 30, 26, 22, and 18, and 14 degrees centigrade. Total fatty acids were analyzed by gas chromatography. The percentage of the fatty acids which were unsaturated was lowest (24 percent) in cultures grown at 38 degrees centigrade which was also the temperature at which *Chlorella sorokiniana* grew most rapidly. The percentage of unsaturated fatty acids was also low (34 percent) at 14 degrees centigrade. At intermediate temperatures, as much as 43 percent of the fatty acids were unsaturated. This is in contrast to reports in the literature that unsaturated fatty acid composition in plants always increases as environmental temperature decreases.

Project K-10

The Laser As A Light Source For The Photosynthesis and Growth of *Chlorella*

The effects of coherent radiation produced by a Helium-Neon Continuous Wave Gas Laser on the photosynthesis and growth of *Chlorella* were contrasted with white light and light from a Grating Monochromator. No detrimental effects of the laser on the organism were demonstrated. However, the lased light was 20 percent more efficient in producing growth at 25 degrees centigrade and 100 percent more efficient at 30 degrees centigrade when contrasted with white light of equal intensity.

Measurement of photosynthetic rates under equivalent conditions with the three light beams gave further evidence for the greater effectiveness of the laser beam. Contrasting the laser beam with a white light beam demonstrated a 30 percent greater rate with the laser. When the laser was compared with light from the monochromator, the efficiency of the laser in stimulating photosynthesis was 20 percent greater. The greater long term effectiveness of coherent radiation over non-coherent radiation in the light-dependent region of photosynthesis demonstrates a new and useful technique for studying the photosynthetic mechanism.

Project K-11

DAIRY SCIENCE

Summer Annual Forages for Lactating Dairy Cows

Lactating cows were fed one of three forages: (1) pearl millet grown on plots with a high level of potassium and limestone; (2) pearl millet grown with no added potassium and limestone; or (3) sudangrass grown with the same fertilization as treatment 1. Butterfat content of milk from cows fed pearl millet was significantly lower than from cows receiving sudangrass. In addition, the fertilization treatment of pearl millet produced a significantly lower fat test than the pearl millet treatment with no added fertilizer. The depression observed with pearl millet was greatest during periods of low rainfall and butterfat tests were not depressed during a period of heavy rainfall. A summary of results from previous years demonstrates that the magnitude of butterfat tests is positively correlated to the amount of rain which falls during the growing season. Agronomic studies indicate that fertilization increases and rainfall decreases the cation content of the forages.

Project BG-2

Cropping Systems for Dairy Farms: A Study of the Growth Responses of Corn and Alfalfa to Soil Fertility and Irrigation: with Concurrent Lactation Studies on the Effects of Corn Silage and Alafalfa Hay and Energy Levels on: Milk Production and Composition and the Physiology of Cows

In the third and final lactation of this study, the cows fed corn silage as their only forage continued to produce as well as those fed half of their forage as second-cutting alfalfa hay. The production level was acceptably high for both groups being over 14,500 pounds of milk and 550 pounds of fat. The differences in the fat, protein and solids not fat production were small. Although the number of cows that remained on the experiment during all three years was smaller for the group receiving only corn silage as their forage. This was due to the loss of cows at the end of the first lactation because of the apparent iodine deficiency. Just as many cows finished two successive lactations in the group receiving only corn silage as in the group receiving hay. When iodized salt was included in the ration, it overcame the problem of the apparent iodine deficiency.

The possibilty of relying entirely on corn silage as the forage in a dairy operation can be considered with the knowledge that milk production and composition will be satisfactory. However, in such a feeding program special attention should be given to the supplementation of protein and minerals, especially calcium and iodine.

Project BG-3

Chemical Changes in Milk Fat As Related to the Flavor of Milk

Supplementation with tocopheryl acetate is an effective means of controlling oxidized flavor in milk; however, the added cost may be prohibitive in some cases. Green forages are good sources of tocopherol (vitamin E) and provide equally effective control of oxidized flavor. Preservation of vitamin E-rich forage for winter feeding is difficult since the vitamin is relatively unstable. Conventional hay-making results in about 90 percent loss of the vitamin. Ensiling, however, was shown to be an effective means of preserving vitamin E. Studies in progress are aimed at determining optimum harvesting conditions for various forages with respect to maximizing the vitamin E content. Commercial dehydration was also found to be an effective means of preserving vitamin E. A feeding trial showed that feeding 5-10 pounds per cow per day of dehydrated alfalfa pellets as part of the normal hay roughage provided sufficient vitamin E to control oxidized flavor.

Project G-34

Studies on the Mode of Digestion, Absorption, and Utilization of Feeds by Ruminants and Their Associated Bacteria

A surgical technique has been developed to create a "simple stomach-like" animal from young ruminants. The esophagus is surgically removed from its attachment at the rumen and attached to the wall of the abomasum (esophageal - abomasal anastomosis) so that the food bypasses the first three compartments of the ruminant stomach.

The development of a diet which permits successful rearing of the "bypass" calves has been a limiting factor in the use of these animals in developing long range nutritional studies. The inability of the animal to consume large quantities of feed and the adverse effect of fibrous feeds must be considered in developing a useful ration.

Blood studies indicate that the acetate level increased and the free fatty acids decreased with increasing age. The greatest change in the acetate level was between 30 and 60 days of age, though the changes were not as great as those of the normal control calves. The blood glucose pattern for the bypass calves did not appear to be different from that noted in control calves.

Project G-39

Methods of Processing and Other Factors Affecting the Quality of Ice Cream

Results of studies on the use of low dextrose equivalent corn syrups and maltose containing syrups as sweetener agents indicate that these ingredients are effective sweeteners for ice cream and other frozen dairy foods.

Corn syrup solids were successfully

used as the only source of sweetener. Studies show that the low dextrose equivalent corn syrup solids are suitable ingredients for the Parevine-type products.

Project G-42

Nutritive Value of Bermudagrass

Midland Bermudagrass was harvested at approximately 30 and 40 days after a previous harvest with 200 or 600 pounds of nitrogen per acre. The four hays obtained from the combinations of cutting dates and nitrogen level were fed to steers to determine relative intakes and digestibility values. The ten day delay in cutting date resulted in a decline of digestible energy of about 8 percent and a reduction in intake of 0.5 pound of dry matter per 100 pounds of body weight per day. The effect of nitrogen level, while it does affect yield per acre, did not produce any significant change in either intake or digestible energy. The results from these trials and others demonstrate that when precise harvesting schedules are followed, a high quality forage can be obtained with Midland Bermudagrass.

Project G-47

Flavor Quality of Concentrated Milk Products Is A Factor In Milk Utilization and Marketing

The lipid composition of rumen digesta from cows on two distinctly different diets has been studied. One type of digesta was from cows on a high-grain, low-hay diet, and the other type was from cows on a high-hay, low-grain diet. The characteristics of the lipid material in these two types of digesta were distinctly different.

The major digesta lipid fraction, long chain free fatty acids, was composed of approximately 80 percent stearic acid, 10 percent unsaturated C_{18} fatty acids, and 7 percent palmitic acid in the high-grain digesta. The comparable fraction from the high-hay digesta contained approximately 40 percent stearic acid, 20 percent unsaturated C_{18} fatty acids, and 30 percent palmitic acid.

High-grain diets for lactating cows are well known to produce low fat test milks. This phenomenon may be associated with the strain put on the cow to metabolize the high levels of stearic acid.

Project G-48

Continued Study of New Reproductive Hormone

Studies have continued on the reproductive hormone regulating a portion of the female cycle which we reported last year. Development of a quantitative assay system has occupied much effort this year and is nearing completion. This hormone, ULH, appears to be a high molecular weight protein or at least, carried by such a protein. It has been found that another smooth muscle, mucosa source (cattle small intestine) can also influence the cycle.

Project G-50

Nutritive Value of Corn Silage

Intake and digestibility values were obtained with dairy steers on six corn silages (Pioneer 1097, 22.1 percent dry matter, low planting rate; Pioneer 1097, 45.0 percent dry matter, low planting rate; Pioneer 1097, 36.8 percent dry matter, high planting rate; Pioneer 1097, 20.5 percent dry matter, high planting rate; Dekalb XL-45, 49.4 percent dry matter, high planting rate; Dekalb XL-45, 20.5 percent dry matter, high planting rate). The four silages obtained from Pioneer 1097 were almost identical in digestibility except that the high rate of planting with 36.8 percent dry matter had a lower digestibility. The Dekalb XL-45 silages, while higher in ear content, did not average any higher in digestibility than Pioneer 1097 silages but did have a higher digestible energy content at the lower dry matter content. Intake rates tended to follow dry matter content with greater intakes for the higher dry matter silages.

Project G-52

A Study of the Development, Improvement, or Standardization Of Manufacturing Processes for the Production of Various Cheeses and the Effect of Specific Factors on the Flavor, Body and Texture of These Cheeses

Studies have been continued to develop products and techniques through which the tremendous quantity of dried cheese whey solids available in the United States might be utilized. Since this product has a lactose content of approximately 70 percent, studies were initiated to develop a method to prepare a wine through yeast fermentation of whey solutions. The lactose fermenting yeasts used in the study were Saccharomyces lactis and Torula cremoris. Both sweet and acid wheys were used. Because of the more optimum acidity for alcoholic fermentations, the wines prepared from acid whey solutions developed higher levels of ethyl alcohol, very dry flavor and clean characteristic wine bouquet. Proteolytic degradation resulted in all sweet whey trials. Slower fermentation rates also resulted in these trials. In all instances, ethyl alcohol was the only alcohol that was produced. Attempts were made to ferment whey solutions with Saccharomyces ellipsoideus after the lactose was hydrolyzed by a commercial lactose preparation to its component monosaccharides. No alcohol production was analytically detectable in these trials.

Acid and sweet whey solutions

were supplemented with various levels of sucrose and fermented with the lactose fermenting yeasts. Similar results were obtained relative to alcohol content and odor of the non-sucrose trials. The resultant products did possess very desirable flavor properties of sweet wine.

Project G-53

Analysis of Production and Feed Data from Dairy Records

A comprehensive survey of the Maryland dairy industry, conducted in cooperation with the Department of Markets, State Board of Agriculture, was completed. This survey included 3,539 farms with 149,163 milk cows and 57,358 replacements. Information on herd size, tank size, type of milking system, and type of housing was collected and tabulated. The results provide a description of Maryland's dairy industry and a means of studying recommendations of adjustments indicated to maintain efficient production and marketing facilities.

Since the number of herd replacements raised largely determines the extent of genetic progress that can be made by culling, current Maryland DHIA data are being summarized to relate turn-over rate and calving rate to herd size and production level. A preliminary summary indicates that the average turn-over rate is greater than the number of replacements raised, leaving little opportunity for culling.

Statistical analyses of Maryland lactation and herd summary records, representing several years of data, are also being conducted to relate such variables as breed, age, weight, herd size, breeding, and feeding practices to production and income. The results of these analyses should yield valuable information upon which breeding, feeding, and management recommendations can be based, and could also point to ways to improve the present system of recording and reporting production and feed information.

Project G-54

Factors Influencing the Absorption, Transport, Retention and Excretion of Pesticide Chemicals in Dairy Animals

Dairy animals receiving residues of heptachlor epoxide during periods of non-milk production retain such residues in their body tissue. When milk production resumes, the stored pesticide is excreted into the milk. The level of residue in milk can be predicted from an analysis of body tissue. The concentration of pesticide in body fat is essentially the same as that in milk fat when no pesticide is being consumed. These conclusions are based on experiments with pre-first-lactation heifers and mature cows during their normal dry period. Some of the heifers had been on residue-free feed for several months before lactation began. Milk is the primary route of excretion of pesticides such as heptachlor epoxide. These studies show that such residues cannot be fed during any part of the dairy animal's life cycle if pesticide-free milk is to be attained.

Project G-55

ENTOMOLOGY

Chemical Control of Insect Pests of Sweet Corn

Resistance by corn to attack by corn earworm is a part of the total picture of chemical control because it can be integrated with chemical control. In 1967, five lines of corn were planted and evaluated for resistance to corn earworm and the factors responsible for the resistance were critically examined. It was found that the factor of silk balling was more closely associated with resistance than was husk extension or husk tightness. Ears infested after pollination were more severely damaged than ears infested before pollination.

Seven compounds were evaluated for control of corn earworm, dusky sap beetle and European corn borer. The most significant of these materials was Gardona (Shell) which is effective against corn earworm and dusky sap beetle and is relatively safe. Experiments on the timing of sprays for control of European corn borer indicated that sprays applied before tasseling were not as effective as those applied after tasseling or after silking.

Project H-29n

Chemical Control of Orchard Insects

Evaluation of concentrate spray equipment was shifted from a commercial orchard to a 300-acre orchard which had been abandoned for 2 years. The 6-acre test block was surrounded on four sides by unsprayed trees. Three types of spray equipment were used to apply concentrates from 3 to 33x. Results from these tests furnished proof that the 10 and 33x concentrates were as effective as the standard 3x in controlling apple pests under the most extreme conditions. Fruit from the 3, 10, and 33x concentrate sprayed trees had above 95 percent clean fruit, whereas those from unsprayed check trees had less than 18 percent clean fruit.

Seven acaricides were evaluated against a heavy population of European red mite, *Panonychus ulmi* (Koch). Applications were made with a handgun as a dilute spray. Four of the new acaricides gave as good or better control as was obtained with the standard recommended materials. These acaricides showed enough promise to warrant further testing.

Project H-48

Insecticide Residues in Soil

Analyses of phorate and disulfoton in soil treated for control of green peach aphid on spinach have been done in order to determine the behavior of these insecticides under cold weather conditions compared with normal summer weather. Generally speaking, phorate was degraded faster than disulfoton in the soil and the degradation of both materials was faster in the spring and summer than in the winter. A number of oxidative metabolites of both insecticides were found in both the soil and the spinach. Most of the residues present consisted of the sulfone derivatives of the parent compounds, materials which are at least as toxic as the applied compounds. These results show that where spinach is intended to overwinter in the field for a spring harvest, control of the green peach aphid with disulfoton or phorate will not be practical because of high residues. Dimethoate, another systemic organophosphate, has been applied to winter spinach and the results are being analyzed. Dimethoate is more persistent on spinach during the winter than in the summer, a not unexpected result. Efforts are continuing to evaluate the behavior of insecticides for control of the green peach aphid on overwintering spinach.

Project H-67

Alfalfa Insects, Their Biology and Control

In the 1966 growing season, emphasis was placed on the evaluation of seven insecticides, including some unregistered materials. Results suggested that the previously recommended malathion-methoxychlor combination was the most effective of the formulations tested. Attention was given to the effect of insecticides on predators and parasites. Spiders showed a high tolerance to methoxychlor, malathion, parathion and carbaryl. Damsel bugs, big-eyed bugs, ladybird beetles and lacewings are other predators of alfalfa weevil larvae as well as aphids. Careful observations have shown that these insects do not become very abundant prior to the first cutting of alfalfa, and consequently they cannot be depended upon to play a significant role in preventing damage by alfalfa weevil larvae. After the first cutting these predators are more abundant in alfalfa fields, but their presence does not preclude the necessity for a second spray in many cases.

Although spiders have shown promise as major predators of weevil larvae, their habits are such that artificial rearing and distribution does not appear to be practical. Emphasis is being placed on more detailed studies of wasp parasites in the hope that procedures can be developed for mass rearing and artificial distribution on a large scale. Wasp parasites have shown more promise than predators.

Project H-71-d

Physiology of Insect Reproduction

Detailed studies were completed on the sexual behavior of adult virgin male and female mosquitoes of precisely known ages using the forced-mating technique. The adult females ranged in age from newly emerged (0 hour) to 24 hours old. The males were all 48 hours old. The individual coital times of females which were subsequently found to have been inseminated ranged from 4 to 398 seconds, with an average of about 72 seconds. The individual coital times of those females which were subsequently found not to have been inseminated ranged from 4 to 16 seconds, with an average of about 7 seconds. About 50 percent of the 0-24 hour old females could be force-mated, and about 75 percent of these were inseminated.

The sexual behavior of adult virgin males was individually tested by presenting to each male 15 virgin females of precisely known ages in a numbered sequence. The males' responses to these females were graded as either feeble, moderate, active, highly active or withdrawal. It was found that most individual males would not accept a series of 10 females in a definite sequence. Only one out of the 40 males studied copulated or attempted to copulate with all 15 virgins. About half of the adult males used showed detecable responses to virgin females with the forced-mating technique. The other half of the males used were unaccountably non-reactive to virgins. About 72 percent of these reactive males exhibited moderate to highly active copulatory reflexes.

One hundred females which had been caged with males for 48 hours were individually offered to a series of 1 to 5 virgin males by the forced-mating method. It was found that only one of the cage-mated females could be force-mated. On the other hand, it was found that 5 out of 50 females which had been force-mated 12 hours earlier would force-mate a second time.

Project H-72

The Mosquito Fauna in Selected Swamps, Marshes and Impoundments

In 1966, additional information on the ecological and seasonal distribution of *Culiseta melanura* was obtained. This mosquito is responsible for the maintenance of the virus of eastern encephalitis in birds. Other species of mosquitoes are known to transmit the disease from birds to horses and from birds to man. *C. melanura* females which are engorged with blood are collected in light traps and box traps. These mosquitoes are brought to the laboratory where the blood of the host is later analyzed. Results have shown that most *melanura* females feed on birds rather than on mammals.

Project H-73-a

Biology and Control of Tobacco Insects

It is essential to the profitable production of Maryland tobacco that sprays applied for control of green peach aphid be applied as efficiently as possible. Profit margin is narrow and therefore insect control can be neither extensive nor expensive. In 1967, some studies were conducted with spray machinery in order to evaluate objectively how such spray machinery can best be used. Factors of spray volume, pressure and nozzle arrangement were evaluated. Spray coverage experiments evaluated with a carbamate leaf print technique showed sprays from 30 to 60 gallons per acre produced the best coverage. All other factors being kept constant, pressure had no effect on coverage. An experiment that compared spray booms showed that sprayers equipped with drop booms gave better coverage than those that did not have drop booms.

Other research which was con ducted in 1967 indicated the rela tive effectiveness of four systemic in secticides, applied both as foliar sprays and as granules applied to the soil. Of special interest was Temik (Union Carbide) which gave excel lent control of aphid and reduced injury by flea beetle. Furadan (Nia gara) did not reduce injury by aphids as much as Temik but was outstanding in reducing injury by flea beetle. AC47031 (American Cyanamid) and Meta Systox R (Chemagro) were both effective fo liar sprays.

Project H-74

Comparative Morphology and Physiology of Insect Blood Cells

Quantitative and analytical studies of the effects of selected pathogenic agents on the blood cell picture of the fall armyworm should permit an accurate evaluation of the still unresolved question of whether the blood cells of insects constitute a major or minor internal defense system. Before undertaking such studies, it is essential to have very detailed information on what kinds of cells are normally present in the blood at different stages of the healthy insect's development, what changes occur normally in the percentages of these different types, and the number of blood cells in circulation. Further, one mus have detailed information on how these normal values are affected by such factors as: (a) starvation (infect ed insects may cease to feed), (b) in jection of simple diluents (diluent will be used to inject certain path ogens) and simple inert particle (pathogenic particles will be inject ed in later studies). Detailed studie on many of the above problems were begun and are continuing.

Project H-76

Loblolly Pine Cone Insects in Maryland

In 1966, it was learned that the most destructive pine coneworm, *Dioryctria ametella,* has two and probably three generations per year in Maryland with overlapping of generations and no clear-cut broods or population peaks. The rather erratic behavior of this insect can be attributed to variations in the duration of the inactive period of the larvae in response to temperature. It therefore appears impractical to use chemical control measures against the adult moths. Tests with systemic insecticides were conducted but were inconclusive. Additional work with granular systemics is planned with the objective of protecting pine cones from coneworm damage to increase seed production.

Project H-83

Host Preference of Alfalfa Weevil, Hyperia Postica in Relation to Plant Produced Attractants and Repellents

The alfalfa weevil has a marked "preference" for alfalfa, and the objective of this project is to identify the substances produced in the plant which apparently attract the weevil. Although the weevil will feed on certain clovers, it appears that legumes other than alfalfa do not attract the weevil or else they repel the weevil. The volatile components of 7 legumes were studied to determine possible stimulants affecting feeding and egg-laying behavior of the weevil. It was found that only alfalfa, red clover, and alsike clover contained materials which were attractive to the weevil. The presence of an egg-laying stimulant was confirmed in alfalfa, and results suggest that a material in sweet clover plants also stimulates egg-laying. Attempts to characterize the chemical nature of the feeding stimulant and the egg-laying stimulant are continuing. Also studies are continuing to determine the sensory mechanisms in the weevil which enable it to detect the chemical stimulants.

Project H-84

Transformations of Insecticides by Plants

Several researchers have reported conflicting routes of metabolism of the organophosphorus insecticide dimethoate. There are two possible reasons for the conflicting data: (1) different species of plants were used in their work, and (2) different modes of administration of the compound to plants were used. Research at the Maryland Agricultural Experiment Station has now shown that there are only minor differences in the metabolism of dimethoate caused by different modes of application. Degradation of dimethoate in green beans occurred most rapidly in excised leaves, followed by stem-injection, root treatment, and least rapidly by foliar application. The metabolites produced were substantially the same in all modes of application. The important metabolite from a toxicological standpoint, the oxygen analog, was consistently present in moderate amounts in plants treated by all four modes of application. Des-*N*-methyl dimethoate, a metabolite which has been heretofore reported only in animals, was detected in trace amounts in beans while two other metabolites which may be of toxicological significance were also found in some samples. In all cases hydrolysis was the predominant route of metabolism of dimethoate. Another organophosphorus insecticide, Mocap, has been studied in beans in an effort to facilitate the registration of the material for use in Maryland. This material has a rather novel structure, and the metabolism of the compound by plants should yiel some interesting new information Thus far, several metabolites have been detected in plants, one of which results from an unusual chemical reaction and is a new type of metabolic product from an organophosphorus insecticide. These studies wil materially aid our understanding o the behavior of insecticides after application to crops and will make i easier to evaluate the potential hazards involved in their use.

Project H-85

The Biology of Biting Midges of the Genus *Culicoides* in Maryland

Culicoides or biting midges, punkies, no-see-ums as they are called locally, continue to be a problem in Maryland because of their attacks on man and domestic animals. A survey of their breeding sites and maintenance of a laboratory colony to study their biology was undertaken.

Our surveys throughout the state yielded 14 species of *Culicoides,* and the breeding sites of 12 species were located. A colony of *C. guttipennis* was maintained through generations in the laboratory with up to 9,000 eggs per generation with 97 percent hatching success. A successful technique for feeding the adults on rabbits was developed Tests of artificial media for feeding larvae were conducted with only partial success.

Project H-86

The Control of Bird Depredation

The depredation of blackbirds and starlings on Maryland crops continues to be a serious problem particularly in eastern portions of the state. Attempts to alleviate damage to corn and grapes were conducted in cooperation with the federal government and nine other states.

Further testing of TEM (Triethylene Melamine), a drug that temporarily sterilizes birds, was done using corn as a bait. The corn, soaked in a solution containing TEM placed on platforms in a selected marsh, reduced the hatching of eggs in the test area. Further tests at a different dosage will be conducted in subsequent years.

The banding of red-winged blackbird nestlings in the study areas and the banding of blackbirds caught in large decoy traps was continued.

Scaring devices including plastic owls, and recorded starling distress calls were tested. The distress call is effective in moving birds.

Project H-87

Oxidation of Organophosphorus Insecticides in Mammals

Several organophosphorus insecticides have structures which can be attacked by mammalian enzyme systems resulting in either activation or detoxification of the compounds. Some of the insecticides under investigation in the past year were phosphamidon, Bidrin, Azodrin and dimethoate, all materials susceptible to oxidative dealkylation of the substituted amide portions of the molecules. The des-*N*-ethyl derivative of phosphamidon, a metabolite which is more toxic than the parent material, was detected in the milk of a goat and in the urine of a goat and rats which were treated with phosphamidon. Other metabolites also detected which are toxic to mammals are the completely unsubstituted amide analog of phosphamidon, and the dechlorinated unsubstituted amide, neither of which have been reported before. Other metabolites have been detected whose structures have not been completely elucidated. The maximum level of these materials in goat milk was only 0.025 p.p.m. Similar metabolites from dimethoate-treated animals have been sought, but considerable difficulty has been experienced in fractionating metabolites isolated from the urine. It is thought that the reactions leading to the type of toxic metabolites noted above occur in the liver of mammals. Experiments have been conducted in which chemicals which are known to stimulate liver enzymes have been administered in conjunction with these insecticides. The toxicity of phosphamidon, Bidrin and Azodrin is decreased while the toxicity of dimethoate is greatly increased. This indicates that the liver enzymes must have an effect on other parts of the molecule which are not expected. Efforts are being made to utilize liver fractions to study these reactions *in vitro*. The aim of these studies is to better understand the effect of oxidation of these insecticides on their toxicity to mammals. This information will be of great assistance in evaluating possible side effects from the application of these insecticides in agricultural practice.

Project H-90

Utilization of Amino Acids from Protein in College Women

The purpose of our human nutrition study was to determine if wheat gluten has comparable nutritive value when its amino acid pattern was adjusted with crystalline amino acids to the FAO pattern as compared to a control diet of pure crystalline amino acids in the FAO pattern. Protein was fed at a 0.5 g per kg body weight to 12 college women 19 to 22 years of age. After a preliminary natural protein diet of 10 days, one-half the group was fed the amino acid control diet and the other half received the wheat gluten. At the end of 10 days the diets were reversed. Greater nitrogen retention was evident during the crystalline amino acid control diet than during the wheat gluten diet. The urea and ammonia nitrogen was higher during the wheat gluten diet than the crystalline amino acid diet. Since the wheat gluten amino acid mixture was inferior to the pure amino acid diet this would indicate some loss or unavailability of certain amino acids especially some of the essential amino acids, thereby decreasing the efficiency. The increase in the excretion of urinary ammonia is a factor in the evaluation of wheat gluten since the excretion of urinary ammonia is related to the acid-based balance of the body fluids. If the increase in urinary ammonia could be prevented by the addition of a substance other than wheat gluten, then the efficiency of this protein would be increased.

Project Y-4, NE-52

HORTICULTURE

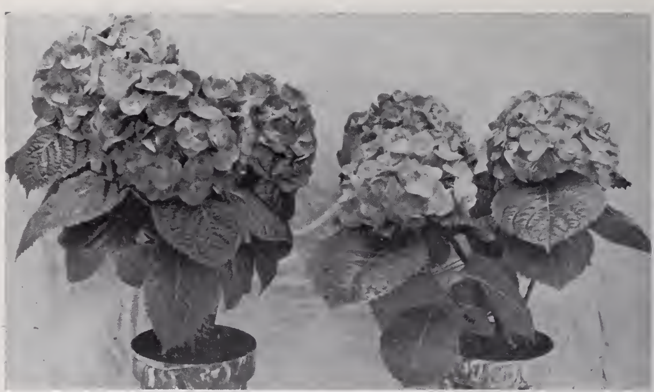
Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Potted Plants

Culture of Hydrangeas

The hydrangea forced in greenhouses for sale as a spring flowering potted plant (*Hydrangea macrophylla*) is sometimes called the pink-blue hydrangea because of the change in flower pigment from pink to blue in the presence of aluminum in the cell sap although white (unpigmented) varieties are also produced. A recent decline in popularity and resulting decline in sales from Maryland greenhouses has led to studies aimed at simplifying production procedures, improving plant quality, and in testing and selecting for better types and varieties. Plants for forcing are grown in the open in the summer. Following flower initiation, which was shown to occur naturally from mid-September to late October depending on variety, plants are given cold storage and then take from 85 to 100 days to come into flower in the greenhouse.

Early work at this station showed that flower color not only depended upon soil acidity and aluminum availability but upon the total fertilizer program. High potassium fertilization favored blue flowers while pink flowers were favored by high nitrogen and high phosphorus fertilization in addition to the usual liming practices. Thus, our recommended fertilizer program for the production of pink flowering hydrangeas has been a weekly application of an aqueous solution containing 3 pounds of a 25-10-10 fertilizer to each 100 gallons. Should the soil be more acid than pH 6.5, three pounds of ammonium phosphate should be substituted in up to 3 applications. For the production of blue flowers, the soil should be unlimed, or acidified to pH 5.5, and fertilizer at forcing should be the weekly application of 2 pounds of 20-20-20 or potassium nitrate per 100 gallons of water and 3 applications of aluminum sulfate at 15 pounds per 100 gallons. During the summer growing period, fertilizer requirements were found to be met adequately by 1½ pounds of 25-10-10 fertilizer to 100 gallons of water applied biweekly. Fertilizers applied constantly through the irrigation water were successful when the dilution rate was 3 ounces of 25-10-10 per 100 gallons of water in the summer and 8-10 ounces of the same material per 100 gallons of water during forcing.

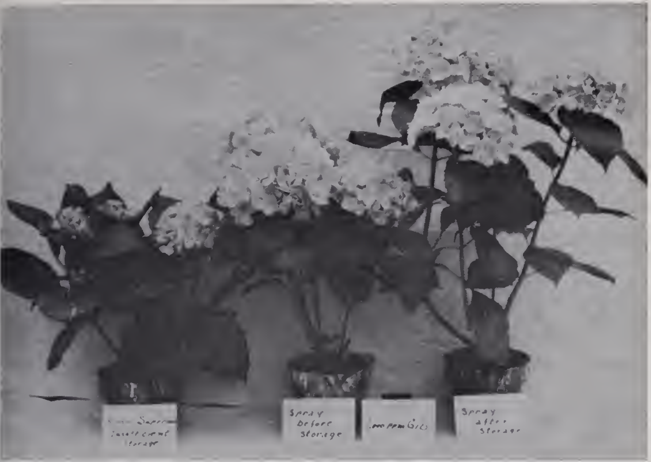
The flower initiation of hydrangeas was found to be stimulated by night temperatures of 65°F or cooler and by long night conditions. Approximately 6 weeks of such treatment were adequate for flower initiation where shoots were actively growing.



Plant at left shows increased growth following a single spray of gibberellin A-3 (Hydrangea variety 'Todi').

Experiments on the cold requirements for satisfactory forcing showed that temperatures of 35-45^{0}F were most effective with 50^{0}F being less effective and 55^{0}F being essentially ineffective. Six weeks of treatment were adequate for good forcing characteristics on well-matured plants but 8 weeks were necessary when plants were put in storage by October 1 instead of October 25. It was also shown that defoliation was desirable prior to forcing and that hand removal of leaves was beneficial where defoliation was not complete upon removal from storage. Removal of leaves prior to storage was shown possible by a spray of the chemical butynediol but such defoliation had adverse effects on flower formation under certain conditions. Defoliation in storage was effected satisfactorily by vapors from 30 ml per 1,000 cu. foot of storage of the trade name material Vapam and this could replace the older practice of placing apples in the storage room. Very recent trials have shown a possibility of inducing hydrangea defoliation by a spray of 2-chloroethylphosphonic acid. This material, however, acts as a dwarfing compound and can only be used where this secondary effect is also desired.

A chemical dwarfing compound, succinic acid, 2, 2-dimethylhydrazide (B-nine), has been shown to be effective in retarding the growth of hydrangea stems during the summer or the greenhouse forcing period. Trials showed that treatment during the early forcing period also reduced the size of the inflorescence. Further work has shown that heavy applications in August (up to 10,000 ppm) can retard summer stem elongation, retain a retarding effect on the stems



Gibberellin can increase growth of hydrangea (variety 'Rose Supreme'). Plants with inadequate cold storage sprayed with 1000 ppm gibberellin A-3 (center) before storage or (right) after removal from storage.

at forcing, but not reduce the size of the inflorescence. In many cases the inflorescences have been larger and recent work has attempted to predictably define the conditions where shorter stems can be had with larger inflorescences.

Recent work has shown some potential in the use of gibberellin as a partial substitute for the cold storage f hydrangeas, thus enabling pot lants to be forced earlier. The conentration, time, and number of aplications of gibberellin applied as a oliar spray in relation to duration nd temperature of cold storage are urrently undergoing study.

In cooperation with Maryland hydrangea growers, many new varieties and seedling selections have been evaluated against standard varieties. Two standard varieties remain outstanding in ease of culture and quality, 'Rose Supreme' (light pink) and 'Merveille' (medium pink or medium blue) while only one newer variety, 'Todi', has shown significant promise, due to its earliness.

Project I-74-a

Flower Structure Important in Peach Thinning Sprays

Because of the failure of all post bloom chemicals for spray-thinning of the peach, investigations have been reopened with caustic dinitro compounds applied during blossoming. Of the two heaviest setting varieties in Maryland, Redhaven has been relatively easy to thin whereas Redskin has been very resistant to blossom sprays.

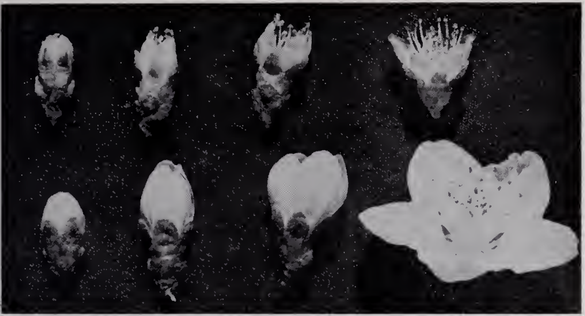
A detailed study of bud survival indicates that differences in structure of the flowers are related to survival. The Redskin has large petals which enclose completely the interior flower parts until an hour or somewhat longer before the flower is fully open. The Redhaven flower, however, has exposed stigmas when the flower is still in a tight bud stage (see photo), or for several days before the flower opens fully. Further, it is apparent that well before the opening of the Redskin flower, anther sacs have released pollen in the protected enclosure, and thus many flowers are already pollinated before opening.

Detailed counts were made of survival of several thousand flowers of each variety in four stages of development (see photo) when sprayed with dinitro-o-sec-butyl phenol at concentrations up to 1 pint per 100 gallons. Results indicate that until Redskin flowers are sufficiently open to admit spray material, thinning cannot be achieved. Redhaven flowers, on the other hand, are susceptible to thinning action of the spray as soon as stigmatic surfaces are exposed. The consequences of structural differences in the flower must be considered in the development of any spray-thinning program during blossoming on the peach.

Project L-74-B

Early stages of Redhaven flower development showing exposed stigmatic surface in unopened bud (right).

Redskin flowers immediately prior to opening. Note well protected anthers, some of which have already released pollen.



Stages of blossom development in bud survival study. Above: Redhaven; Below: Redskin.

Chemical and Non-Chemical Measures for the Protection of Perishable Food Commodities in Marketing Chemicals

Botrytis (gray mold) and *Rhizopus* rot (soft rot) are serious problems in the marketing of fresh strawberries. Short shelf life due to the high rate of respiration also reduces market value as well as quality. Studies are in progress to decrease berry respiration and combat fruit rots. Reducing oxygen levels to 2 percent and increasing the carbon dioxide content of the atmosphere surrounding the fruit to 10 percent, lowered the occurrence of *Botrytis* when compared to air checks. *Rhizopus* development was reduced by all CA treatments but the rate of decrease was not as great as was *Botrytis*. Results indicate that berries of much better quality could be delivered to the consumer if fruit in transit more than one day was transported in CA.

Project L-79-G

Movement of Solids During Freezing of Fruits and Vegetables

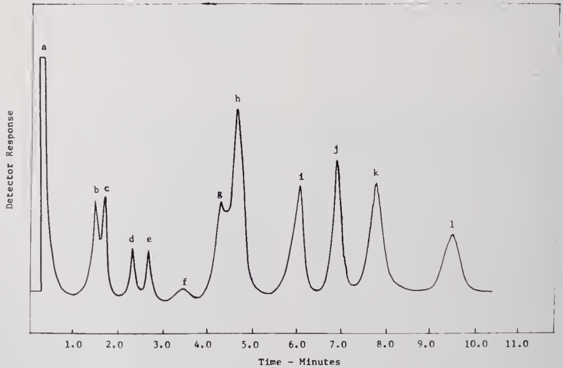
It has been theorized for many years that the reason for loss of quality of frozen foods is due largely to the production of ice crystals which puncture cell walls causing "drip" and loss of firm texture. More recent studies have indicated that loss of quality upon freezing is perhaps even more a result of movement of solids in advance of the "freezing front." Thus, as the water at the surface of the product freezes, the soluble solids (mostly sugars and acids) migrate to more central parts of the commodity being frozen, thereby leaving the outer portion of the product tasteless. Recent studies under this project revealed that such a movement of soluble solids occurs only if the cold is applied from the top. Under these conditions there is a very substantial movement of solids in a downward direction. If, however, the cold is applied from the bottom as in the case of plate freezing where the product to be frozen is placed on a cooling plate, the solids are occluded among the ice crystals and do not migrate. Thus, for maintenance of a uniformly good flavor of frozen foods, contact plate freezing is more desirable than blast freezing, particularly if the cold air is applied from above.

Project Q-58-m

Gas—Liquid Chromatographic Measurement of Fruit Cell Walls

Fruit cell walls must remain relatively unchanged to insure proper texture i.e. firmness or hardness for good eating or processing quality. Recently developed gas liquid-chromatographic techniques have assisted in fingerprinting cell wall components of fruits, thereby increasing the information regarding textural changes that take place during maturation and cold storage.

In apples, for example, firmness is principally related to the amount and proportion of the pectins, hemicellu-



Gas chromatographic analysis of trimethylsilyl derivatives of fruit cell walls. a. Pyridine. b. α-L-arabinose. c. β-L-arabinose. d. α-D-xylose. e. β-D-xylose. f. α-D-galactose. g. y-D-galacturonic acid + α-D-galactose. h. α-D-glucose + β-D-galactose. i. α-D-galacturonic acid. j. β-D-glucose. k. β-D-galacturonic acid. l. N-acetyl-D-glucosamine.

lose and cellulose in the cell wall. Pectins and hemicellulose hydrolysates can be satisfactorily separated in a gas chromatograph on an SE 30 column at 175 degree centigrade as trimethylsilyl derivatives. These derivatives make the break-down products of the cell wall extremely volatile.

The various cell wall constituents such as arabans, xylans, galactans, galaturonic acids and glucans can be determined in a single analysis which acts as a fingerprint. These fingerprints can help determine methods to extend storage life, develop best storage conditions and give the consumer better fruit.

Project Q-58-p

Fall Application of Fumigants and Plastic Mulches for Cantaloupes Is Tested

The use of soil fumigation with polyethylene mulches increases the total and marketable yields and increases the earliness of cantaloupes. Melons grown on mulched plots ripen 10 days to 2 weeks ahead of those not mulched. Fumigation is valuable for control of soil borne pests and weeds.

The time of application of the fumigant and plastic mulch in the early spring is critical, but delays may result from unfavorable weather conditions, excessive soil moisture, or the schedule of the custom applicator. Some time lapse between appliation and seeding is necessary to btain adequate fumigant activity nd to allow the chemicals to diminsh to levels safe for planting. Fall pplication would avoid many of the roblems associated with application n the spring. A study was conducted o determine the feasibility of applyng fumigant and plastic mulch in he fall for cantaloupes to be planted he following spring.

Three broad-spectrum soil fumiants—MC-33, Vapam, and Vorlex—were applied in late October with each of the following plastic mulch treatments: 1.5 mil clear polyethylene, 4 mil clear polyethylene, 4 mil clear polyethylene resistant to ultra violet light, and 1.5 mil black polyethylene. Control treatments with and without fumigants were included in which the mulch was applied but was removed prior to planting in the spring.

Cantaloupe plants were started in peat pots in a hot bed and were transplanted through openings in the mulch in early May. All the mulch materials withstood the winter very well. It was expected that some deterioration of the 1.5 and 4 mil clear polyethylene not having ultra-violet resistance might occur, but none was evident either at the time of planting nor during the next several weeks. At the end of the harvest period some breakdown of these materials had taken place, with the 1.5 mil showing more deterioration than the thicker material. However, by this time the mulch had served its purpose and was no longer needed.

Vine growth, early yields, and total marketable yields all showed the mulch treatments to be superior to the unmulched controls. Response to the clear polyethylene was greater than to the black but did not appear to be related to the type or thicknes of the materials. There was littl difference in overall response to th 3 soil fumigants but MC-33 ap- peared to promote earlier maturity.

Project Q-77

Application of polyethylene and fumigant for cantaloupes.

Cantaloupe Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation

Leaf blight, incited by *Alternaria cucumerina* (Ell. and Ev.) J. A. Elliott, is a serious disease of cantaloupes in Maryland. The disease is present each year, but it is more severe during wet, humid seasons. The symptoms first appear as small brown spots which enlarge to form circular necrotic areas. The leaves curl, dry up and drop from the plants. The defoliation results in reduced production and fruit quality. Some varieties are resistant to leaf blight; however, the fruit production and quality is quite low under Maryland conditions.

The development of varieties having resistance to leaf blight is an objective of the cantaloupe breeding project. Greenhouse and field screen ing tests were established and 25 varieties and breeding lines wer screened for resistance to leaf blight Artificial inoculations were made i the greenhouse, but natural infectio was relied upon in the field.

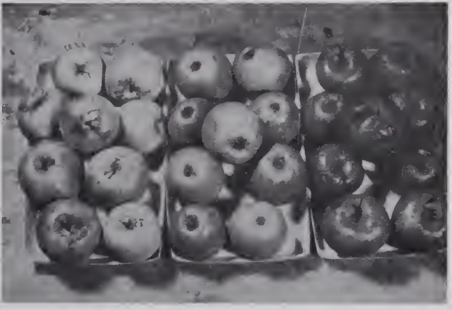
All the varieties and lines excep 2 were rated as susceptible in bot the greenhouse and field tests. Th 2 types rated as resistant had a hig level of resistance since there wa very little disease development on th foliage. The 2 resistant types will b used in a study of inheritance o resistance and for the development o resistant varieties.

Project Q-8

Effect of Gases on the Preservation and Flavor Development of Plant Materials

Previous work on this project demonstrated that peeled, diced fruits or vegetables could be preserved by being exposed to gases such as carbon monoxide, which is lethal to browning enzymes, and followed by other gases which are lethal to microorganisms. In this way such products could be stored for months without any change in fresh product quality. Similar work was done with whole apples to determine if their storage life could be extended, or if they could be held for long periods of time at other than cold storage temperatures. The results, as shown in the photo, indicate that carbon monoxide did have a beneficial effect in extending shelf-life of whole fresh apples. Ethylene oxide, however, even when applied following carbon monoxide, caused a rapid discoloration of the apple skin and tissues directly under the skin surface.

Project Q-84-A



Type of Can Affects Quality of Processed Sweet Potatoes

Occurrence of severe can-corrosion in some lots of processed sweet potatoes has caused processors to use enamel-lined cans instead of the tin-lined cans normally used. To determine the possible effect of the coating type on processed product appearance, Nemagold sweet potatoes were processed as syrup and vacuum packs in cans with six types of coatings. After 3 and 12 months storage, the product in the tin-lined cans was bright orange in color while that from the enamel-lined cans showed the characteristic enzymatic darkening. The product from the tin-lined cans remained virtually unchanged upon exposure to air while that from the enamel-lined cans continued to darken. The presence of a "high-tin fillet" on the seam of one can type did not result in the bright appearance of the product as in the tin-lined cans.

Tests with a number of varieties confirmed the results with Nemagold. With varieties having a more active polyphenolase system, the difference between the products packed in tin lined and enamel-lined container was even more pronounced.

Project Q-84-B

Enzyme Found Associated with Corrosion of Tin-Lined Cans

Instances of severe internal can-corrosion (removal of tin coating) by canned vegetables have increased in recent years. With processed sweet potatoes the severity of corrosion is influenced greatly by variety. For example, Goldrush usually induces heavy corrosion while Nemagold induces little. Since corrosivity levels seem to be associated with levels of polyphenolase activity of the varieties, experiments were designed to determine if the polyphenolase system was a causal factor in can corrosion. Corrosion was greatly reduced when the polyphenolase system wa inactivated before processing. The nitrate level in the sweet potato had n effect upon the development of corrosion when the polyphenolase syste was effectively inhibited before processing.

It is postulated that quinone formed by the polyphenolase utiliz tin, removing it from solution, thu permitting additional tin to dissolv and resulting in corrosion of the tin plate.

Project Q-84-B

Use of Tomato Cannery Wastes as Food and Feed

Waste disposal problems of food processors are becoming an ever increasingly burdensome problem. Under this project, an attempt is being made to eliminate as much as possible of this waste material by utilizing it in a useful manner as food or feed. Thus far it has been determined that ruminants will accept cannery wastes of tomato processing plants, particularly if they are mixed with other materials such as corn cobs. Tomato vines can also be used as ensilage provided they are chopped and compressed so that anaerobic fermentation ensues. Under these conditions ruminants will utilize the material and their gains will be intermediate between corn and alfalfa silage, depending largely on their protein content.

Efforts have also been made t extract protein from these tomat wastes, since the protein content ma be as high as 22 percent of the solids Thus far we have succeeded in extracting up to 60 percent of the protein by a relatively simple process Such a "tomato protein concentrate" could then be used for food or for feed

Project Q-85-A

POULTRY SCIENCE

Poultry eggs and meat continue to be one of the most economical sources of high quality protein for the American housewives. They are one of the few products that have continued over the last years to sell at an ever-decreasing price while prices for all other commodities gradually increase. The explanation for this phenomenon lies in the fact that poultrymen have continued to increase the efficiency of poultry production. Increased efficiencies have been made in many areas, including the more economical use of labor and feed ingredients. The industry has been most progressive in applying research results to the production of poultry. The research areas covered vary widely, but in essence fall under the three large categories of nutrition, breeding and processing. The nutrition area attempts to find more economical diet combinations that will adequately meet the nutritive requirements of the bird. The breeding area works toward the goal of producing birds that better meet the demands of the consumer and that use feeds more efficiently. The area of processing and marketing has as its goal the improved efficiency of the actual preparation of the birds for ultimate consumption. The research carried on by the Poultry Science Department of the University of Maryland and reported herein is of both a fundamental and practical nature, but even the research which is relatively fundamental or basic in nature is problem-oriented. The research laboratories and field stations of the department are always open for inspection, and we are glad to discuss with interested parties the current projects.

Helminths Infection in Chickens

Mixed White Rock male chickens were infected with the roundworm *Ascaridia galli*. The recovery of worm was highest at 17 days (7.7 worms per bird). The ratio of male o female worms changed gradually; at 23 days after infection it was 0.64, while at 60 days, it was 0.88. The dose of embryonated eggs (50-130 eggs per bird) had no inluence on the number of worms reovered. *A. galli* were also used to nfect sex-linked cross birds, Rhode sland Red males with Barred Plymouth Rock females. The female hickens harbored fewer worms than the male chickens. Worms recovered from both sexes of this cross weighed less than those worms recovered from the White Rock male chickens. The lipids from worms which developed under different conditions are being analyzed.

Mixed White Rock male chickens were infected with the cecal worm, *Heterakis gallinae*. Blood was drawn from the birds prior to infection and at 5, 10, 14, 24, 38 and 48 days postinfection. The infected birds had significantly higher total protein levels on the 10th and 14th days, than the controls. These days of infection corresponded to the 3rd and 4th moult of the worm.

The albumin level was significantly higher in the infected birds than in the controls on the 10th day. Although the globulin level was higher in the infected birds throughout the experiment, there were significant differences only at 10 and 1 days. The cholesterol level of th blood was significantly higher in th infected birds at 5 days postinfe tion, corresponding to the parasite second moult.

Project M-5

A Study of Causes of Bruising in Transportation of Live Broilers from Farm to Processing Plant and Possible Methods for Their Reduction

Bruising in broilers continues to be a major cause of loss in quality as well as loss in yield. It is impossible to make definitive studies of bruises as they accidentally occur in the field; to overcome this limitation, a machine has been devised that will uniformly inflict a bruise on the surface of birds. Bruises were inflicted, and after varying lengths of time, the resulting bruises were classified and measured. Analysis showed that there were significant differences in bruising by varying the force and surface area used. A high force and a small area created the largest bruises. The influence of differences in weights of birds was studied. However, the weight range used was not large and no differences were found to be due to bird size. The sex of the bird did not seem to influence size of bruise. It was found that the thighs were more easily bruised than breast tissue.

A separate experiment indicated that the degree of fattening or finish was a major cause of variation in bruising when uniform forces were used. This appeared to be more important in influencing the amount c bruising than was the fleshing of th bird. Following the above prelimir ary work, 55,000 birds grown in fiv field trials were sampled for bruisin as well as other quality defects. Thes birds were grown over a period of complete year and following are som of the indications from this study:

(1) Sexes differed slightly, wit females bruising somewhat more eas ly than males.

(2) Birds grown under artificiall controlled low light intensity tende to bruise more easily than bird grown under normal light.

(3) Highly finished birds bruise more easily than birds that did no carry as much subcutaneous fat.

(4) Highly pigmented bird tended to bruise more easily thar others.

(5) The method of handling with in the field appeared to possibly ex ert some influence on the degree o bruising.

(6) The adjustment of the process ing machinery had an influence or degree of bruising.

Project M-61

Effects of Gonadal Hormones on Embryonic and Postnatal Bone Growth in Chickens

Work completed during the year included four trials involving embryos and five involving growing chicks. Androgenic treatment of embryos produced no changes in either bone growth or accessory sexual organs. However, estrogenic treatment consistently produced genetic males with oviducts, and in approximately 50 percent of the embryos, ovotestis were noted.

The trials on growing chicks involved treatment with diethylstilbestrol, testosterone propionate, or both hormones. Estrogen treatment alone resulted in an increase in body weight in both sexes, due primarily to increased fat deposition. Androgen alone produced no changes in body weight or bone size, but the combined estrogen-androgen treatment produced a shortening of the long bones of growing chickens without significant changes in body weight.

Tests for serum calcium, phosphorous and alkaline phosphatase indicated that treatment with the combined hormones results in a sharp rise in serum calcium during the two week period following initial treatment at three weeks. However, this change is temporary. There were no significant changes in serum phosphorous or alkaline phosphatase. Results to date indicate that the changes in bone growth caused by the combined estrogen-androgen treatment are probably due to increased deposition of calcium in the epiphyseal areas of the growing long bones, but histological studies will be necessary to confirm this hypothesis.

Additional trials, involving the same treatments will be conducted during the coming year.

Project M-64

Applied Broiler Nutrition Studies

Studies have been conducted to determine the requirement for available lysine, total sulfur amino acids, glycine, sodium, calcium and phosphorus by broilers during the starting and finishing periods. The effect of nergy and protein levels on feed equirement has also been investigated. The three studies were conducted to determine the range of ptimum sodium levels in broiler tarting and finisher diets. These reults show that 0.14 percent sodium was adequate for growth but feed conersions were improved slightly up to 7 percent. It seems possible that some practical rations, low in fish meal, could have been silghtly sub-optimal in sodium. These studies required the analysis of several practical ingredients for sodium content and the development of improved composition data of feed ingredients with respect to sodium.

Two studies were also conducted to study the relationship of calcium level on phosphorus requirement and to insure that the University of Maryland recommendations were sound. In addition, floor pen studies were also conducted during the year on the effect of added selenium and potassium to practical simplified broiler rations. Both studies yielded negative results although it is believed that under some conditions in Delmarva, selenium may be deficient under stress conditions. But more work is required under diseased stress conditions.

A chick bioassay was developed and described for determining the availability of sodium in defluorinated rock phosphate. The chick bioassay, using the parallel line assay technique was conducted. It was found that the availability of this product was approximately 82.9 percent.

In addition, two studies were conducted to determine whether or not practical broiler rations might be limiting with respect to the amino acid glycine. Results of these studies indicated that as little as 72 percent of the NRC requirement was adequate and further additions were of no benefit when fed under practical conditions. This has limited, therefore, concern for glycine level of practical diets which otherwise would have become a costly factor in practical feed formulation.

Project M-66

A Thermolabile Chick Growth Inhibitor in Wheat

Wheat germ meal was found to have thermolabile factor (s) which reduced growth, blocked absorption of fat, and caused pancreatic hypertrophy in chicks. Factor (s) which blocked absorption of protein by pancreatin and caused hemolysis of red blood cells were extracted.

Autoclaving for 45 minutes at 15 pounds pressure and 121°C degree destroyed the harmful effects.

Project M-67

Genetic Adaptation for Broiler Breeding Stock

To be economically useful, a male line of birds used in the production of commerical broiler chicks must transmit to these chicks high rate of growth and other characteristics of economic importance. The strains of birds commonly in use are very commendable in this respect but have a relatively low amount of viability themselves, and thus succumb to the hazards of the poultry house. A project has been initiated to attempt to determine if it is possible to combine excellent economic traits along with high viability. The stock is in its second generation of selection, having been produced from crosses of currently available commercial strains. Twenty individual male matings are employed annually, and a total population of approximately 2,000 are grown annually. Birds are being selected on the basis of viability and growth rate.

Project M-68

The Relationship Between the Activity of the Kreb's Cycle Enzymes and Fertilizing Ability of Fowl Spermatozoa

The problem of infertility in chickens is one that is continually with us. The industry loses literally millions of dollars annually from eggs that are set but are infertile. Many approaches to the problem have been and are being followed. One interesting observation on fertility seemed worth pursuing; that is, the known relationship between fertility and comb type. One would have no reason to presuppose that comb type would influence fertility, yet this seems to be a case of a pleiotropic effect; that is, two unrelated responses being caused by the same genetic variable. Homozygous rose-comb males were secured. These were known to have low fertility rates in relation to single-comb birds of the same strain. A study was made of some of the enzymes in the semen of rose- and single-comb birds. The enzymes studied included fumarase, aconitase, isocitric dehydrogenase and malic dehydrogenase. Chicken sperm proved to contain an appreciable amount of all four enzymes in a soluble form. It was found that one of these enzymes, fumarase, was correlated with fertility, and it is proposed that the low level of fumarase in the sperm of homozygous rose-comb males may be at least in part the reason for the low fertility. It is felt that the fundamental knowledge secured may be useful in subsequent research on the problem of fertility.

Project M-69

Quality Retention in Poultry Meats As Influenced by Methods of Processing

Some research has been carried out concerning the influence of feeding NH_4Cl on the albumin quality of eggs. One of the important constituents of egg white is ovomucin. A high percentage of ovomucin is associated with high egg quality. The feeding of NH_4Cl seemed to consistently increase by about 7 percent the amount of ovomucin in egg white. On a dry weight basis, there was a 10 to 15 percent increase in ovomucin, and this resulted in an increase in the Haugh unit score of from 10 to 15 points. The eggs from treated birds had a consistent increase in N_2 as determined by the Kjeldahl method.

The results are extremely preliminary, but do indicate that it may sometime in the future be possible to improve egg quality through feeding regimes.

Project M-100

Study of Chick RBC Transketolase as an Index of Thiamine Nutriture

Studies involving measurement of he red blood cell transketolase enyme as a primary measure of thiamine nutriture have been continued. Although vitamin B_1 (thiamine) is not considered to be a limiting nutrient in most practical poultry rations, marked variability in thiamine content of corn during storage can result in sub-optimal levels under certain circumstances. This, coupled with the use of antithiamine drugs for disease control, suggests the need for a method of appraising the thiamine adequacy of practical poultry flocks by means of RBC transketolase assay.

Studies at the University of Maryland have been directed toward establishing requirements for broiler chicks as related to fat content of the diet. In addition, the possible sparing effect of the vitamin, biotin, on the minimal requirement for thiamine is being investigated.

Project M-207

Use of Chick Bioassay in Measuring Specific Amino Acid Availability

Bioassays for available lysine and available methionine content of feed ingredients have been performed on a large number of practical feed ingredients important in the formulation of poultry rations. These include a large number of fish meals of different types and origins. A summary of the values obtained are given in the table.

Type of Fish Meal	Chick Bioassay (% of Prot.)	
	Lysine	Methionine
Menhaden	7.3 ± 0.5 (27)	3.4 ± 0.34 (25)
Anchovy, Peru	6.8 ± 1.02 (21)	3.1 ± 0.30 (17)
Anchovy, Chile	7.4 ± 0.22 (4)	3.2 ± 0.21 (7)
Nor. Herring	7.1 ± 0.64 (12)	3.3 ± 0.13 (13)
Cnd. Herring	7.9 ± 0.26 (8)	3.4 ± 0.09 (8)
E. C. Herring	7.8 ± 0.19 (4)	2.2 ± 0.03 (4)
Tuna	6.2 ± 0.74 (6)	3.3 ± 0.29 (6)
Blue Crab	4.3 (1)	2.2 (2)
King Crab	3.5 (1)	2.1 (2)

() = No. of Samples

In addition to the development of these improved values for these amino acids, nutrient composition data of feed ingredients have been summarized, including the data on available amino acid content, and made available for feed industry. These feed composition data are in widespread use, especially for formulation for broiler rations.

Project M-208

Effect of Protein Level and Amino Acid Balance on Voluntary Feed Consumption

Several experiments were conducted in which chicks of the same age but of widely different carcass composition (1.8 to 25.4 percent body fat) were fed diets with deficient, adequate and excessive levels of methionine in cold, normal and warm ambient temperature environments. Differences in body composition had a pronounced effect on voluntary feed intake and weight gain, especially in the cold. Non-obese chickens consistently consumed at least 2 to 3 times as much feed as did obese chicks, with corresponding changes in body composition back to normal within approximately 2 weeks. Blood serum protein, albumin and uric acid levels were inversely related to changes in body fat content, while blood glucose levels were not affected.

Other work has involved the use of lysine-low, protein-adequate diets to inhibit feed consumption and sexual development of broiler breeder replacements pullets. This method of retarding the development has been compared with other methods commonly used for retardation of sexual development in meat-type breeder pullets to increase the egg size during early weeks of production. The use of a diet containing .26 percent lysine and 15 percent protein has been found to give excellent results when started at either 6 or 8 weeks of age.

Project M-209

Determination of Amino Acid Requirements of Growing Broiler Chicks and Laying Hens

Considerable work has been done at the University of Maryland with chicks reared in floor pens and in battery brooders to determine more precisely the minimal needs of broiler chicks for available methionine and available lysine as measured by chick bioassay. These amino acids, together with total sulfur amino acids, are of extreme importance in routine practical broiler ration formulation based on the Maryland data.

The total sulfur amino acid requirement for the broiler can be expressed as:

For weight gain (0-4½ wks.) $\hat{y} = 118.7 \log X + 129.8$
For weight gain (4½-8 wks.) $\hat{y} = 166.8 \log X + 116.9$
For energy conversion (0-4½ wks.) $\hat{y} = 81.4 - 80.84 \log X$
For energy conversion (4½-8 wks.) $\hat{y} = 89.9 - 112.6 \log X$

The available lysine requirement for the broiler can be expressed as:

For weight gain, 0-4½ wks. $\hat{y} = 36.2 \log X + 110.3$
For weight gain, 4½-8 wks. $\hat{y} = 67.9 \log X + 109.9$
For enegry conversion, 0-4½ wks. $\hat{y} = 85.1 - 50.2 \log X$
For energy conversion, 4½-8 wks. $\hat{y} = 84.8 - 97.0 \log X$

where X is the percent of amino acid in diet and $\hat{y}$ is the percent relative weight gain or energy uptake per unit gain, as appropriate.

In addition, data on methionine intake and performance of laying hens have been collected and are being evaluated.

Project M-210

The Relationship Between Cathepsin Level and Leucosis

Leucosis, a cancer-like disease, is still the number one killer of poultry, and one of the major causes of condemnation during inspection in dressing plants. Genetic differences in susceptibility to leucosis exist between strains within breeds. Efforts to relate these differences to measurable blood enzyme levels have led to experiments to select populations of birds having high and low levels of the enzyme cathepsin in blood serum. Of all enzymes studied, this enzyme is most consistently elevated in resistant strains. Selection of these lines has progressed up to the second generation. With the exception of the enzyme level, there appear to be no performance differences between these lines. Considerably more information is needed before any conclusions can be made.

Project M-303

Effect of Protein Adequacy on the Efficiency of Selection for Early Fattening of Turkeys

Originally turkeys were employed in this project, but the turkey facilities were lost and the original scheme has been continued using the Coturnix quail. Lines of birds have been selected on the basis of their growth rate on lysine-deficient and lysine-adequate diets.

Eight generations of selection for early fattening and lysine utilization have now been completed with the Coturnix quail. During the first hour generations of selection, little or no progress was made in improving the percent growth rate in either the full-fed line, or the line selected for growth while being fed a lysine-deficient diet. There was a gradual increase in four-week body weight in both lines. However, during the past four generations, percentage growth rate has improved in both lines, with the rate of increase being slightly greater in the deficient line. While there has been a slow, gradual increase in adult body weight, there have been no changes in hatchability, mortality, sexual maturity, egg weight, or egg color.

When the birds that had been selected on the deficient diet and those selected on the control diet were grown both on a deficient and a control diet, it was found that birds that had been grown on a deficient diet grew more rapidly than those selected on a control diet when they were both fed a deficient diet. When both lines were grown on a control or adequate diet, those that had been selected on this diet grew somewhat better than those selected on a deficient diet. We feel we are making slow but steady progress in the selection of a line of quail that will grow well on a lysine-deficient diet.

It remains to be seen whether or not the strain which can grow adequately on a lysine-deficient diet will indeed have different body composition from the control strain, when they are both grown on adequate diets.

Project M-400

VETERINARY SCIENCE

Respiratory Diseases of Poultry

As part of an industry-wide eradication program, continued studies were made of serological testing procedures for detecting the presence of the chronic respiratory disease agent, *Mycoplasma gallisepticum,* in flocks of chickens and turkeys. A total of 143,596 chickens from 2,692 flocks, and 7,330 turkeys from one flock, were tested by the serum plate agglutination test. Positive reactions were observed in 12,169 samples, or eight percent of the total. During 1965-66, 39 percent of 116,107 samples were positive. There was less difficulty in interpreting the test than in previous years.

Studies were undertaken to determine the cultural and serological characteristics of *Escherichia coli* (*E. coli*) isolated from birds affected with "air sac" disease. Similar studies were made on *E. coli* organisms from the intestines of normal, healthy control birds. The biochemical characteristics of the field isolates were more diverse than those organisms isolated from control birds. Identification of pathogenic types on this basis was not possible. In addition, rapid passage of these organisms in media and chicken embryos indicated that these characteristics were unstable.

Serological studies revealed a wide range of antigenic types among the field isolates. Due to the antigenic variation among types of *E. coli* found in field outbreaks, immunization of chickens for control of this problem would be difficult. As little cross-protection between types is afforded, an effective vaccine would need to contain numerous strains of the organism.

Project D-52

Bovine Mastitis

An investigation was made to determine *in vitro* antibiotic sensitivity on hemolytic coagulase positive *Staphylococci* from various areas of the state. Five hundred cultures were studied using low concentrations of antibiotics. Ninety percent of the cultures were sensitive to neomycin, aureomycin and tetracycline, while eighty-two percent were sensitive to terramycin and bacitracin. Less than seventy percent of the cultures were sensitive to penicillin and less than twenty-five percent were sensitive to triple sulfa or polymixin. This study shows that an increasing number of pathogenic *Staphylococci* involved in mastitis are becoming resistant to the antibiotics commonly used for treatment.

In our epidemiological study on hemolytic *Staphylococci,* approximately 400 cultures from various areas of the state have been phage typed. Most herds are carrying three or more different types of *Staphylo-*

cocci. The *Staphylococci* are most commonly typed by Seto's 1, 3, 5 bovine phages and the adapted phages P52 and A10.

In general herd surveys on 2,300 dairy cows in Maryland, 3,346 quarter samples were positive out of 9,061 quarters tested. Hemolytic *Staphylococci* were isolated from fifty-two percent, pathogenic *Streptococci* from forty-two percent, and other miscellaneous bacteria from six percent of the positive quarters.

Project D-58

The Investigation of the Floruescent Antibody Technique with Respiratory Diseases of Poultry

The organism causing infectious coryza of chickens, *Hemophilus gallinarum*, was studied by cultural and immuno-fluorescent techniques. A comparison was made of the two methods for identification of the organism. The cultures were propagated in a balanced salt solution supplemented with chicken serum and reduced nicotinamide adenine dinucleotide. Susceptible chickens were inoculated intranasally with actively growing cultures. Three chickens were selected at random for examination every third day from 3 to 30 days postinoculation. Selected tissues were both cultured and examined by the fluorescent antibody method. The hemophilus organisms were identified in 11 instances by fluorescent methods, and 6 times by direct culture. The fluorescent antibody technique afforded a sensitive and rapid diagnosis of *H. gallinarum* in experimentally infected chickens. Increased use of these techniques in the diagnostic laboratories has resulted from these types of studies. Fluorescent antibody techniques have augmented and often eliminated many difficult and time-consuming procedures formerly needed to diagnose some poultry diseases. A rapid diagnosis can be of great value to the poultryman in a disease outbreak.

Project D-59

Reproductive Failure in Cattle: Leptospirosis

Serologic surveys and experimental evidence from experiments with leptospirosis showed this disease entity to be widespread throughout Maryland. A survey of cattle from all counties revealed reactors to all leptospiral serogroups. The use of polyvalent vaccine instead of a monovalent one is to be highly recommended. Annual herd vaccination of dairy cattle has been found to reduce abortions significantly. Comparison of vaccinated and unvaccinated herds confirmed that even though high titers were not developed, effective immunity was obtained. Alteration of serotype virulence was attempted *in vitro* by cultivation in the presence of homologous and heterologous hyperimmune serum in order to develop live, non-virulent diagnostic antigens and vaccines. However, preliminary experiments did not indicate that this method altered virulence or pathogenicity.

There is considerable evidence that

hemolysins are produced by *Leptospira spp. in vivo* and *in vitro.* Sheep exposed to *Leptospirae* after receiving heterologous or homologous hemolysins were refractory to the effect of the exposure.

Calves and hamsters, inoculated with *Leptospira spp.,* were not immune to heterologous exposure. But, clinical, hematologic and bacteriologic signs were diminshed or absent.

Project D-62

Study of Bovine Respiratory Diseases

During the year, 33 clinical specimens were tested for virus isolation, and 203 serums for antibodies. Infectious bovine rhinotracheitis (IBR) virus was isolated from 2 specimens. Thirty-four serums were positive for IBR and 69 for SF-4 virus.

A virus identified as bovine rhinovirus was isolated from an apparently normal calf for the first time in the U. S. The virus was serologically related to 2 other bovine rhinoviruses isolated in Germany. Antibodies to these 3 rhinoviruses were highly prevalent in Maryland cattle.

Relationship of infectious keratoconjunctivitis (pink-eye) virus to IBR virus was studied on the basis of their size and structure, pathogenicity and serum neutralizing ability. The 2 viruses were found to be virtually identical. On the basis of these studies, the pink eye and IBR viruses were, therefore, considered to be the same virus.

An attempt was made to devise a rapid charcoal agglutination test for diagnosis of IBR. Preliminary results were somewhat encouraging. However, further studies were planned to determine the specificity of the test.

Project D-63

Study of the Propagation of Avian Viruses in Tissue Culture

A commercially available non-ionic detergent, Triton WR-1339, was found to inhibit tumors induced by wing web inoculation of 4- to 6-week old chickens with the Bryan strain of Rous sarcoma virus. The drug was administered intravenously or subcutaneously in the region of the tumor. Subcutaneous treatment was begun 8 days postinoculation, at which time the tumors were large enough to be observed and measured. This treatment was found to reduce the volume of the tumor. Intravenous inoculations of the drug were given every 3 days beginning several days before exposure to the Rous virus. Fewer birds treated in this manner developed tumors than did non-treated control birds.

Rous tumor cells cultivated in monolayer tissue cultures were more sensitive to the drug than were similar cell cultures from normal chick embryos and chicken kidneys. The Rous tumor is closely associated with the avian leukosis complex. Serological tests for Rous tumor antibody are frequently used to indicate the presence or absence of lymphoid leukosis. Any chemotherapeutic drug effective against this group of viruses will have considerable value to the poultry industry.

Project D-64

Studies on Bovine Lypmhosarcoma

The experimentation to transmit bovine lymphosarcoma (BLS) to cattle entered its fifth year. To date, 43 newborn calves have been inoculated with BLS material. Of these, one 3-year old bull inoculated with tissue culture of BLS cells and one 3-year old cow given the BLS masses orally with milk, continued, as in the previous years, to reflect lymphocytosis in the monthly blood tests. Two other cows, one inoculated with tissue culture and one with sonicated extracts of BLS, developed a mild degree of lymphocytosis. When slaughtered, the bull was found to have enlarged lymph nodes, but this apparently was not due to neoplasia. Ten other inoculated animals which had circulating lymphoid cells at suspicious to negative levels were found, when slaughtered, to be free of neoplasia.

A transmission attempt was also made with inoculations of mouse lymphosarcoma (MLS) on 8 newborn calves. This material was obtained from mice previously inoculated with BLS.

Purification of this isolated MLS agent by prolonged high centrifugation was attempted six times using material from mice inoculated with the original agent at various passage levels. Also, in an attempt to enhance and accelerate the presumed leukomogenic potency of the MLS agent in cattle, urethan—a chemical compound which was found to induce leukemia in small experimental animals—was injected in 3 calves, which had already been inoculated with MLS.

Project D-65

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1966-1967

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FINANCIAL STATEMENT -- JULY 1, 1966 TO JUNE 30, 1967

	Federal Funds			
	Hatch Amended	*Regional Research*	*Forestry McIntire-Stennis*	*For Agric. Investigations*
Appropriations 1966-1967	$553,798.00	$157,605.00	$ 41,007.00	
TOTALS	553,798.00	157,605.00	41,007.00	
Receipts from sources other than Federal 1966-1967				
State Appropriations for Agricultural Investigations				$1,567,183.49
Special Endowments, Fellowships and Grants				66,772.67
Sales & Miscellaneous				274,109.94
Total				$1,908,066.10
Balance brought forward July 1, 1966				24,303.23
TOTAL				$1,932,369.33
Expenditures:				
Personal Services	$468,953.40	$ 73,953.66	$ 39,921.68	
Travel & Transportation	886.49	2,667.14	2,035.33	
Equipment	46,784.28	52,084.04	1,218.50	
Lands & Structures	909.00	—	—	
Supplies & Materials	26,532.99	19,428.06	940.47	
All Other	9,731.84	9,472.10	376.42	
TOTAL	$553,798.00	$157,605.00	$ 44,492.40	
Balance on June 30, 1967			3,912.74	
TOTALS	$553,798.00	$157,605.00	$ 48,405.14**	

*Including Offset Funds

**Includes $3,912.74 Hold-over funds

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590 The Sturcture of Buganda Rudimentary Sedentary Agriculture. Phillips Foster and Larry Yost. Multilithed Circular, 43 pp. June 1967.

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482 Plant Stands in Maryland Tobacco Plant Beds as Affected by Fertilizer Rates and Irrigation Levels. J. H. Hoyert. 14 pp. March 1967.

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A149 A Revision of the *Chelanus* Subjenus *Microchelonus* in North America Nort of Mexico (Hymenoptera: Braconidae). Charles W. McComb. 148 pp. Jun 1967.

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Technical Bulletins

A148 Peaches in Maryland: A Decade of Soil Moisture and Irrigation Studies Benjamin L. Rogers. 29 pp. June 1967.

Scientific Articles

A1283 The Inheritance of Floret Doubleness, Floret Center Color, and Plan Habit in *Pelargonium hortorum* Bailey. P. E. Nugent and R. J. Snyder Proc. Amer. Soc. Hort. Sci. 91:681-690. 1967.

A1303 Measurement of Particle Size and Its Relation to Quality of Apple Sauce Joseph Lanza, Jr. and Amihud Kramer. Proc. Amer. Soc. Hort. Sci 90:491-497. 1967.

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iscellaneous Publications

91 The Effect of Maintaining Winter Carbon Dioxide Levels in the Greenhouse for Roses, Chrysanthemums, Carnations and Snapdragons Under Different Fertility Levels or in Several Soil Mixtures. James E. Swasey, James B. Shanks, and Conrad B. Link. The Maryland Florist 130:1-9. Oct. 1966.

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2 The Case for Orchard Heating. Aruthur H. Thompson. The Maryland Fruit Grower 37(2):3-8. 1967.

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Department of Poultry Science

cientific Articles

1287 The Relationship of Egg Weight to Chick Weight in Japanese Quail. H. M. Ghany, Edward F. Godfrey, and Helen L. Aull. Poultry Sci. 45(6): 1422-1423. Nov. 1966.

1300 Amino Acid Allowances for Growing Chicks Including Broilers. G. F. Combs. Protein Utilization by Poultry. Pp. 119-136. Publishers: Oliver & Boyd Ltd., Edinburgh. 1967.

1310 The Relationship Between Serum Protein Level and Body Composition in the Chick. O. P. Thomas and G. F. Combs. J. Nutrition 91(4):468-472. April 1967.

iscellaneous Publications

2 Temperature and Humidity—Their Effects on Broiler Performance. Edward F. Godfrey and Paul N. Winn, Jr. Feedstuffs 38(52):34. Dec. 31, 1966.

Department of Veterinary Science

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1265 *Cutebra* Larva Causing Paralysis in a Dog. B. C. Hatziolos. Cornell Vet. 57(1):129-145. Jan. 1967.

1297 Studies on Guaroa Virus. I. Virus Characteristics. Richard W. March and Frank M. Hetrick. Amer. J. Tropical Medicine and Hygiene 16(2): 191-195. March 1967.

1298 Studies on Guaroa Virus. II. Observations in Mice. Richard W. March and Frank M. Hetrick. Amer. J. Tropical Medicine and Hygiene 16(2): 196-199. March 1967.

1299 Studies on Guaroa Virus. III. Experimental Infection of Burros. Richard W. March and Frank M. Hetrick. Amer. J. Tropical Medicine and Hygient 16(2): 200-202. March 1967.

CURRENT PROJECTS

(*These are projects and not publications available to the public*)

Department of Agricultural Economics

Project	
A-18-au	Dairy Adjustments and Supply Response in Maryland and the Northeast. J. W. Wysong.
A-18-av	An Analysis of the Economic Aspects of Beef Cattle Production in Maryland. Sidney Ishee and Graduate Assistant.
A-18-aw	Estimating the Returns to Inputs of Capital and Labor on Maryland Cash Grain and Tobacco Farms. B. V. Lessley.
A-18-ax	Organization of the World's Agricultural Resources. P. W. Foster and Graduate Assistant.
A-18-ay	Profitability of Alternative Feed Handling Systems on Maryland Dairy Farms. J. W. Wysong, J. M. Curtis, and Graduate Assistant.
A-18-ba	Optimizing Returns and Resources on the Eastern Shore of Maryland. Sidney Ishee, J. M. Curtis, and B. V. Lessley.
A-18-bb	Maryland Farm and Open Country Real Estate Transfers. R. A. Murray, J. M. Curtis, and Graduate Assistant.
A-19-aa	The Impact of Economic Investments by Agriculturual Product Processing and Marketing Firms Upon the Areas in Which the Investments Are Made. F. E. Bender and Rudy DePass.
A-19-ac	Comparative Impact of Current and Alternative Systems of Taxation in Maryland on Farmers and Other Economic Groups and Among Counties. W. P. Walker and J. M. Curtis.
A-19-ad	Demand for and Availability of Land and Water Oriented Recreation Facilities in Maryland. D. F. Tuthill and J. M. Curtis.
A-19-ae	An Analysis of the Effect of U. S. Farm Policies on Maryland's Agriculture. G. M. Beal and J. M. Curtis.
A-26-bm	The Export Market for Maryland Agricultural Products. J. R. Moore and Graduate Assistant.
A-26-bo	Analysis of Processing Efficiency and Costs in Broiler Processing Plants. J. C. Maness, J. M.. Curtis, and F. E. Bender.
A-26-bp	An Analysis of the Current Structure of Livestock and Meat Marketing in Maryland and Surrounding Areas with Estimates Concerning the Future Structure. R. F. McDonald and J. M. Curtis.
A-26-bq	Alternative Marketing Systems for Eggs in the Northeast. R. W. Schermerhorn, J. M. Curtis, F. E. Bender, and Graduate Assistant.
A-26-br	Milk Assembly, Processing and Distribution Systems and Practices. G. M. Beal, J. M. Curtis, and Graduate Assistant.
A-26-bs	An Economic Analysis of the Role of Farmer Cooperatives as Marketing Organizations. R. J. Beiter and J. M. Curtis.
A-26-bu	Evaluation of Market Sturcture Performance in Marketing N. E. Fruits and Vegetables. J. L. Cain, J. M. Curtis, and Graduate Assistant.
A-26-bv	Economic Analysis of the Market Structure of the Commercial Fishing Industry in the Northeast. R. E. Suttor and Graduate Assistants.
A-26-bw	An Analysis of the Feasibility of New or Reorganized Agricultural Marketing Facilities in Selected Areas of Maryland: A Model Approach. H. D. Smith and J. M. Curtis.
A-26-bx	Impact of Market Sturcture on Innovations in the Agricultural Industries. J. R. Moore, J. M. Curtis, and Graduate Assistant.

A-26-by	An Economic Analysis of the Forest Marketing Structure in Maryland. Harold D. Smith, James. Burnett, and Graduate Assistants.
A-26-bz	Structure of Maryland Grain Prices. R. F. McDonald and Graduate Assistant.

Department of Agricultural and Extension Education

T-12	An Analysis of the Factors Affecting the Status of Private Forest Recreation Development in Garrett County, Maryland. I. R. Jahns.
T-13	The National Young Farmer Study: Patterns of Effective Class Organization and Course Conduct. V. R. Cardozier.
T-14	A Study of the Process and Product of Evaluation of Secondary School Vocational Agriculture Programs in Maryland. A. H. Krebs and Graduate Assistants.

Department of Agricultural Engineering

R-11-h	Production, Harvesting, Curing and Storing Maryland Tobacco: Mechanization of Tobacco Harvest. (Coop. Department of Agronomy) P. N. Winn, J. H. Hummel, G. J. Burkhardt, E. W. Martin, N. T. Martin, and J. H. Hoyert.
R-18	Development of Equipment and Improved Methods for Harvesting Sweet Potatoes. (Coop. Department of Horticulture) G. J. Burkhardt and L. E. Scott.
R-21	Development and Construction of Specialized Facilities and Equipment for Use in Agricultural Research. G. J. Burkhardt and W. C. Schaefer.
R-22	Principles of Mechanical Harvesting of Fruits and Vegetables. (Coop. Department of Horticulture) G. J. Burkhardt and L. E. Scott.
R-24	Stability of Farm Structures Subjected to Lateral Loads. K. E. Felton and J. G. Cairns.
R-25	Performance Characterisitics of Screw Feeders and Screw Conveyors. G. J. Burhardt.
R-26	Effect of Rate of Displacement on Shear Strength of Soil as Measured with a Torsional Shearing Device. (Coop. ARS, USDA) W. L. Harris and Dale E. Wilkins; J. H. Taylor.
R-27	Effects of Fuel Charge Properties on Performance of LP Gas Engines. W. L. Harris.
RB-11-g	Tobacco Housing. (Coop. Department of Agronomy) P. N. Winn, R. L. Green, G. J. Burkhardt, E. W. Martin, N. T. Martin; O. E. Street and J. H. Hoyert.
RM-1	Environmental Requirements of Poultry. (Coop. Department of Poultry Science) P. N. Winn, N. T. Martin; C. S. Shaffner and E. F. Godfrey.
RHB-23	Application of Energy for Control of Insects. (Coop. Department of Agronomy and Entomology; ARS, USDA) W. L. Harris, W. C. Schaefer, A. L. Steinhauer, N. A. Clark, J. W. Neal, Jr.; and C. C. Blickenstaff.

Department of Agronomy

B-43	Soybean Varietal Improvement. E. H. Beyer and B. E. Caldwell.
B-50	Breeding for Better Dent Corn. R. G. Rothgeb and N. A. Clark.
B-56-i	Breeding of Improved Varieties of Forage Species Adapted to the Northeast. E. H. Beyer.
B-56-j	Pasture Evaluation Using Beef Steers. A. M. Decker, R. Z. Spry, and J. E. Foster.
B-66	Wheat Breeding and Evaluation. R. G. Rothgeb, J. L. Newcomer, J. H. Axley, and Graduate Assistants.

B-67	Varietal Improvement in Barley and Oats. R. G. Rothgeb and Graduate Assistants.
B-73	Morphological and Physiological Responses of Perennial Forage Grasses. A. M. Decker, R. Z. Spry, and N. A. Clark.
B-74	Midland Bermudagrass Hay Production, Feeding Value and Stand Persistence as Affected by Nitrogen Fertilization and Harvest Frequency. A. M. Decker, N. A. Clark, and R. W. Hemken.
B-75	Evaluation of Sod-seeded Forage Species to Supplement and Improve Permanent Pastures. A. M. Decker.
B-76	Red Clover Breeding Investigations. E. H. Beyer.
B-77	Forage Crop Variety Evaluation in Maryland. E. H. Beyer, N. A. Clark, A. M. Decker, and W. J. Moline.
B-79	Use of Herbicides to Control Weeds in Forages. J. A. Meade.
B-85	Late Planting and Winter Survival in Oats. R. G. Rothgeb and Assistants.
B-87	Factors Contributing to Maximum Production in Maryland Tobacco. O. E. Street and J. H. Hoyert.
B-89	Studies of Some Fundamental Physiochemical Relationships of Tobacco with Respect to Cultural, Fertilization, Curing, and Fermentation Practices. O. E. Street, P. N. Winn, Jr., and T. C. Tso.
B-94	The Effects of Physical Characteristics of Herbicides on Efficiency and Mode of Action When Used on Corn and Soybeans. S. R. Colby.
B-95	A Study of the Seed Germination, Rhizome Development and Control Methods of Johnson Grass. J. A. Meade.
B-96	To Investigate the Agronomic Feasibility of Transplanting Tobacco Seedlings in Pressed Peat-Soil Cubes. J. H. Hoyert.
B-97	Differential Harvesting Management of Red Clover and Red Clover-timothy Stands Under Three Levels of Fertilization. A. M. Decker and L. R. Wade.
B-98	Physiological and Biochemical Mechanism of Selectivity of Herbicides. S. R. Colby.
B-99	Factors Related to Irrigation of Tobacco. O. E. Street, J. H. Hoyert, C. G. McKee, and B. W. Byrd, Jr.
B-101	The Effect of Modified Cultural Practices and Environment Control of Curing Upon the Adaptability to Mechanization and Quality of Maryland Tobacco. J. H. Hoyert and P. N. Winn.
B-103	Tobacco Breeding, Testing and Quality Evaluations of Maryland Tobacco. B. W. Byrd, Jr., O. D. Morgan, H. A. Skoog, and A. C. Hawkins.
B-104	Tufcote Bermudagrass—Adapations and Management Requirements for Turf. E. E. Deal.
B-105	Management of Kentucky 31 Tall Fescue for Park Playground and Athletic Field Turf. E. E. Deal.
B-106	Factors Affecting Turf Quality and Rate of Maturity of Bluegrass—Red Fescue Sod. E. E. Deal.
B-107	Effectiveness and Residual Properties of Several Herbicides Used in Turfgrass Areas. E. E. Deal.
B-108	Effect of Fall and Spring Plowing on Soil Moisture, Soil Aggregate Stability and Corn Yield Under Various Cropping Systems. E. Strickling.
BG-2	Summer Annual Forages for Lactating Dairy Cows. N. A. Clark, R. W. Hemken, and J. H. Vandersall.
BG-3	Cropping Systems for Dairy Farms: A Study of the Growth Responses of Corn and Alfalfa to Soil Fertility and Irrigation: with Concurrent Lactation Studies on the Effects of Corn Sialge and Alfalfa Hay and Energy Levels on: Milk Production and Composition and the Physiology of Cows. N. A. Clark, C. B. Kresge, J. H. Vandersall, and R. W. Hemken.

J-95	Development of Improved Strains of Maryland Tobacco Resistant to Disease. B. W. Byrd, Jr., O. D. Morgan, H. A. Skoog, and C. G. McKee.
O-48	Field and Laboratory Soil Characterization Investigations as Related to Soil Genesis, Classification and Utilization. D. S. Fanning.
O-54	Clay Mineralogy of Maryland Soils. D. S. Fanning.
O-55	Soil Tests Studies. J. H. Axley, W. M. Winant, and E. Woolson.
O-57	Behavior of Nitrogen in the Soil. J. H. Axley and J. O. Legg.
O-62	Micronutrient Requirements of Corn on Important Maryland Soils. J. H. Axley, W. M. Winant, and V. A. Bandel.
O-64	Effect of Nitrogen, Phosphorus and Potassium on the Growth and Development of Forages. C. B. Kresge, A. M. Decker, D. F. Champion, and M. G. Schnappinger.
O-71	Nutrient Balance in Orchardgrass as Related to Differential Fertilization. C. B. Kresge and V. A. Bandel.
O-72	The Effects of Soil Aeration, Mechanical Impedance and Temperature on Root Growth. Edward Strickling, D. M. Bandel, C. S. Britt, and G. J. Derco.
O-73	Nutrient Requirements of Summer Annuals for Forage. C. B. Kresge and I. R. Thomas.
O-74	Effect of Differential Fertilization on Forage Production and Chemical Composition of Red Clover. C. B. Kresge.
O-75	The Response of Corn to Fall vs. Spring Plowing Broadcast vs. Plow-Down Fertilizer and Fall vs. Spring Fertilization. V. A. Bandel.
O-76	Effect of Fall and Spring Plowing on Soil Moisture, Soil Aggregate Stability and Corn Yield Under Various Cropping Systems. E. Strickling. (Cross reference with O-76)

Department of Animal Science

C-21	The Effect of Specific Metabolites Upon Growth Rate and General Condition of Sheep. E. C. Leffel, J. H. Soares, and D. F. Wilson.
C-25-a	The Effects of Roughage Preparation. E. C. Leffel, B. C. Patnayak, R. W. Farmer, and D. F. Wilson.
C-33	A Study of the Effect of Menhaden Fish Meal on the Quality of Protein of Swine Diets and on Total Crude Protein Requirements for Growth of Swine. E. P. Young, J. E. Foster, D. G. Snyder, and R. R. Kifer.
C-34	A Study of the Nutritional and Physiological Influences on Variability of Ovulation Rate and Embryonic Survival in Swine. E. P. Young, J. E. Foster, and H. J. Brinkley.
C-35	Studies on the Efficiency and Composition of Growth in Swine as Affected by Protein and Energy Consumption. E. P. Young, E. C. Leffel, and W. R. Bounds.
C-38	A Study of Factors that Influence Feed Consumption by Suckling Pigs. E. P. Young and J. E. Foster.
C-39	Analyses of Records of Beef Cattle Herds in Maryland. J. B. Lingle, J. L. Carmon, W. W. Green, J. E. Foster, and W. R. Stevens.
C-40	A Study of the Use of Measurements for the Evaluation of Beef Breeding Cattle. W. W. Green, W. R. Stevens, J. E. Foster, and J. L. Carmon.
C-41	A Study of Variations in Values of Criteria Used in Selection Indices for Beef Cattle. J. Buric, J. E. Foster, and W. W. Green.
C-42	A Study of Rates of Ruminal Digestion and Absorption for the Rumen. E. C. Leffel, R. W. Farmer, D. F. Wilson, M. H. Abbassy, and J. E. Foster.
C-43	Procurement and Study of the Gnotobiotic Ruminant. E. C. Leffel, J. H. Soares, R. W. Farmer, J. E. Foster, and A. C. Brown.

C-44 Equine Serum Transaminases as Related to Muscular Work and Protein Nutr tion. E. C. Leffel and G. C. DeOms.

Department of Botany

F-12 The Native Plants of Maryland, Their Occurrence, Distribution and Economi Importance. R. G. Brown and R. D. Rappleye.

F-18 Genetic Control of the First Division Association of Homologous Chromosomes and Fertility in *Zea mays* and *Capsicum frutescens.* D. T. Morgan Jr. and R. L. Baker.

F-19 Anatomical, Physiological and Ecological Studies on *Myirophyllum spicatum* L R. G. Brown, R. D. Rappleye, and Graduate Assistants.

F-20 An Ecological Study of the Patuxent Estuary. R. G. Brown, R. D. Rappleye H. G. Gauch, and Graduate Assistants.

J-91 Fungicidal Materials on Cellular Metabolism and Their Usefulness for th Field Control of Vegetable Diseases. H. D. Sisler, J. G. Kantzes, an Graduate Assistants.

J-93 Treatment of Soil and Underground Parts of Plants for the Control of Plan Diseases. O. D. Morgan, J. G. Kantzes, L. R. Krusberg, W. L. Klarman and E. H. Beyer.

J-95 Development of Improved Strains of Maryland Tobacco Resistant to Diseases O. D. Morgan, D. W. Byrd, O. E. Street, J. Hoyert, H. E. Heggested, an H. A. Skoog.

J-97 Physiology and Biochemistry of Nematode and Nematode-Host Relationships L. R. Krusberg, M. C. Gardosik, R. K. Howell, and Graduate Assistants.

J-98 Identification, Characterization and Control of Certain Viruses Affectin Economic Plants in Maryland. H. D. Sisler, O. D. Morgan, and Graduat Assistant.

J-99 The Nature and Control of Diseases of Ornamentals and Turf Grasses i Maryland. G. A. Bean, W. L. Klarman, and Graduate Assistants.

J-101 Forest Tree Seedlings and Soil Fungi Relationships. W. L. Klarman an Graduate Assistant.

K-8-c Biophysical and Biochemical Factors in Plant Nutrition. H. G. Gauch R. W. Krauss, R. A. Galloway, J. D. Lockard, and Russtll Weigel.

K-9 Regulation of Protein and Nucleic Acid Biosynthetic Processes in Plan Tissues. R. J. Mans, E. R. Stout, and Graduate Assistant.

K-10 Nutrient and Environmental Factors Which Affect the Formation of Lipid in Plants. G. W. Patterson.

K-11 Environmental Effects on Growth and Photosynthesis. E. P. Karlander an Graduate Assistants.

Department of Dairy Science

G-34 Chemical Changes in Milk Fat as Related to the Flavor of the Milk R. L. King, D. Bashore, and M. Oskarsson.

G-35 The Analysis of Dairy Products. Ira Katz and Mark Keeney.

G-37 Physiology of Metabolic Diseases of Cattle. W. E. Stewart.

G-39 Studies on the Mode of Digestion, Absorption and Utilization of Feeds b Ruminants and Their Associated Bacteria. W. E. Stewart, J. H. Nicolai R. J. McCormick, and R. W. Hemken.

G-42 Methods of Processing and Other Factors Affecting the Quality of Ic Cream. W. S. Arbuckle.

G-46 The Relationship of the Hypophyseal Growth Hormone and of the Pituitary-Adrenal System to the Productive Capacity of Dairy Cattle for Reproductio and Milk Production. W. F. Williams.

G-47	The Nutritive Evaluation of Forages. R. W. Hemken, N. A. Clark, and A. M. Decker.
G-48	Flavor Quality of Concentrated Milk Products as a Factor in Milk Utilization and Marketing. Mark Keeney, Ira Katz, and J. F. Kunsman.
G-50	Endocrine Factors Affecting Reproduction in Cattle. W. F. Williams, M. Lauterbach, J. O. Johnston, G. Lauterbach, and B. Fagan.
G-52	A Study of Factors Affecting the Voluntary Intake, Availability and Utilization of Nutrients in Forages for Growth and Milk Production. R. W. Hemken, J. H. Vandersall, H. K. Goering, and N. A. Clark.
G-53	A Study of the Development, Improvement or Standardization of Manufacturing Processes for the Production of Various Cheeses and the Effect of Specific Factors on the Flavor, Body and Texture of These Cheeses. J. F. Mattick.
G-54	Analyses of Production and Feed Data from Dairy Records. T. P. Fairchild and J. L. Cason.
G-55	Factors Influencing the Absorption, Transport, Retention and Excretion of Pesticide Chemicals in Dairy Animals. R. L. King, A. Weisshaar, J. W. Lester, and R. W. Hemken.

Department of Entomology

H-29-n	Chemical Control of Insect Pests of Sweet Corn. F. P. Harrison and L. P. Ditman.
H-46-e	Evaluation of New Insecticides on Vegetable Crops. L. P. Ditman, Entomology Graduate Assistants; G. J. Burkhardt (Agricultural Engineering).
H-48	Chemical Control of Orchard Insects. W. E. Bickley, Castillo Graham, and E. R. Krestensen.
H-64	An Evaluation of the Effectiveness of Commercial Insect Control Practices on Canning Crops. L. P. Ditman.
H-67	Pesticide Residues in or on Raw Agricultural Commodities. R. L. Menzer, L. P. Ditman, F. P. Harrison, and E. L. Fontanilla.
H-71-d	Alfalfa Insects, Their Biology and Control. A. L. Steinhauer, J. W. Neal, Jr., and W. E. Bickley.
H-72	Physiology of Insect Reproduction. . C. Jones, David Akey.
H-73-a	The Mosquito Fauna in Selected Swamps, Marshes and Impoundments. W. E. Bickley, J. J. Linduska, and S. R. Joseph.
H-74	Biology and Control of Tobacco Insects. F. P. Harrison.
H-76	Comparative Morphology and Physiology of Insect Blood Cells. J. C. Jones, Daisy Liu, Richard Werner.
H-81	Utilization of the Polyhedrosis Virus for Commercial Control of the Cabbage Looper. L. P. Ditman, Graduate Assistants; and R. N. Hofmaster (Virginia).
H-83	Biology and Control of Loblolly Pine Cone Insects in Maryland. W. E. Bickley, F. E. Wood, and G. J. Smith.
H-84	Host Preference of Alfalfa Weevil, *Hypera postica* (Gyll.) in Relation to Plant Produced Atrractants and Repellents. A. L. Steinhauer, H. Desmond Byrne, and R. E. Menzer.
H-85	Transformation of Insecticides by Plants. Metabolic Transformations of Dimethoate Plants. R. E. Menzer, G. W. Lucier, and Graduate Assistant.
H-86	The Biology of Biting Midges of the genus *Culicoides* in Maryland. D. H. Messersmith.
H-87	Control of Bird Depredation. D. H. Messersmith.
H-88	The Tabanidae of Maryland. P. H. Thompson.
H-89	Development of Controls for Underground Insect Injury to Sweet Potatoes. L. P. Ditman.

H-90	Oxidative Dealkytation of Pesticides. R. E. Menzer and G. P. Clemons.
H-91	The Production and Effectiveness of the Nuclear Polyhedrosis of the Fa Armyworm (Spodoptera frugiperda). L. P., E. D. Thomas (U. of Md. and A. Heimpel (ARS, USDA).
H-92	The Biology and Control of the Lesser Mealworm, *Alphitobius diaperin* Panzer in Maryland Broiler Houses (Coleoptera: Tenebrionidae). J. Davidson, W. E. Bickley, and Graduate Assistants.
H-93	The Influence of Nutritional Variation in the Development of Larvae an Adult Honey Bees. Alfred Dietz.

College of Home Economics

Y-2	Properties of Textile-Furnishing Fabrics and Their Importance to Consum Satisfaction. Eleanor Young, T. Faye Mitchell, and Marie Bell.
Y-3	Fertilization Effects on the pH, Titratable Acidity, Chlorophyll and Caroter Content in Broccoli. Mary S. Eheart and Dale Queen.
Y-4	Utilization of Amino Acids from Proteins. Virginia Dawson, Yvonne Adam and E. C. Cox.

Department of Horticulture

I-74-a	Effect of Environmental Factors and Cultural Practices on the Growth an Flowering of Greenhouse Potted Plants. J. B. Shanks, C. B. Link, an Anthony Steere.
I-74-b	Effect of Environmental Factors and Cultural Practices on the Growt and Flowering of Greenhouse Cut Flower Crops. C. B. Link, J. B. Shank and James Swasey.
I-74-c	Cultural and Management Studies for the Production and Maintenance Woody Plants. C. B. Link, F. R. Gouin, and Thomas MacCubbin.
I-79-l	Physiological Differences of Winter and Summer Flowering Varietits Snapdragons as Related to Growth and Flower Quality. C. B. Link an J. B. Shanks.
I-79-m	Relationship of the Mineral Nutrients and of Nutrient Levels to the Growt and Development of Certain Woody Ornamental Plants Growing in Container C. B. Link and F. R. Gouin. .
I-79-n	The Influence of Temperature and Photoperiod on the Growth and Flowerir of the Greenhouse Carnation, *Dianthus caryophyllus* L. C. B. Link. B. Shanks, Dan Eltzroth, and Charles Elstrodt.
L-74	Environmental Factors and Cultural Practices in Relation to the Growt and Fruiting Responses of Fruits. A. H. Thompson and B. L. Rogers.
L-74-b	Chemical Thinning of Peaches. A. H. Thompson and B. L. Rogers.
L-74-c	Size Control of Fruit Trees with Chemicals. A. H. Thompson and B. L. Roger
L-79-f	Measuring Post-Harvest Biochemical Changes Affecting the Market Qualit of Fresh and Processed Peaches. L. E. Scott, J. C. Raulston, M. D. Moor and Glenn Shaw.
L-79-g	Chemical and non-Chemical Measures for the Protection of Perishable Foc Commodities in Marketing Channels. L. E. Scott, G. J. Stadelbache M. D. Moore.
L-79-h	Mineral Nutrition of the Apple with Special Reference to Calcium, Manganes and Iron. A. H. Thompson. D. C. Ferree, B. L. Rogers, and H. Gauch.
L-100	Vegetative Propogation of Pine by Needle Fascicles. R. L. Baker an I. C. Haut.
Q-58-a	Rapid Nutritive Evaluation of Processed Vegetables. A. Kramer.
Q-58-k	Development of Specifications for Canned Food Quality. A. Kramer, E. Scott, and B. A. Twigg.

-58-m	Development of New Products and Improved Processing Methods. A. Kramer, B. A. Twigg, R. C. Wiley, and Mildred Modery.
-58-n	Suitability of New Varieties of Horticultural Crops for Canning and Freezing. W. L. Hollis, F. F. Angell, and L. E. Scott.
-58-p	Quality Improvement of Canned Apple Slices and Sauce Through Studies of the Relation of Water Insoluble Constituents of the Fresh Fruit to the Textural Quality of the Processed Product. R. C. Wiley, A. H. Thompson, M. M. Modery, T. Chase, M. Tavakoli, R. H. Dougherty, and Y. S. Lee.
-58-r	Quality Maintenance, Measurement and Control in the Marketing of Vegetables Including Potatoes. A. Kramer, R. C. Wiley, B. A. Twigg, W. L. Hollis, Mildred Modery. S. Angel, and J. Rasekh.
-58-s	Quality Maintenace, Measurement and Control in the Marketing of Vegetables Including Potatoes. A. Kramer, B. A. Twigg, H. S. Todd, and L. Hodgson.
-74	A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland. W. L. Hollis, L. E. Scott, and F. F. Angell.
-77	Crop Management Studies with Vegetable Crops. C. W. Reynolds, W. L. Hollis, and F. C. Stark.
-77-b	Efficacy and Selectivity of Chemical Herbicides for Controlling Major Weed Species in Truck Crop Production. J. D. Long, W. A. Matthews, G. J. Stadelbacher, and F. C. Stark.
-81	Cantaloupe Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation. F. F. Angell and F. C. Stark.
-81-b	Sweet Potato Breeding and Selection with Particular Reference to Quality and Resistance to Cracking. F. C. Stark, L. E. Scott, W. A. Matthews, and F. F. Angell.
-81-c	Genetics and Breeding of Sweet Corn. R. J. Snyder.
-81-d	Tomato Breeding and Selection with Particular Reference to Adaptation to Mechanical Harvest and to Processing. F. F. Angell, F. C. Stark, Dorothy A. Eiker, and M. L. Robbins.
-81-e	*Asparagus officials* Breeding and Genetic Studies. R. J. Snyder and Graduate Assistants.
-81-f	Breeding of Horticultural Crop Plants. R. J. Snyder, C. B. Link, J. B. Shanks, F. F. Angell, I. C. Haut, and F. C. Stark.
-83	Soil—Plant—Water Relationships. C. W. Reynolds, F. C. Stark, and R. J. Adkins.
-83-b	Root Distribution and Root Density of Selected Vegetable Crops as Related to the Absorption of Soil Water and the Uptake of p_{32}. C. W. Reynolds and W. A. Matthews.
-84-a	Effect of Traces of Oxygen and Other Gases on the Preservation and Flavor Development of Plant Materials. A. Kramer, S. J. Palmer, and J. Kaffezakis.
-85-a	Utilization of Solid and Liquid Wastes Formed in the Manufacture of Vegetable and Cheese Products. A. Kramer, J. F. Mattick, E. C. Leffel, J. H. Axley, I. Ben-Gera, Wie Han Kwee, Byong Yoo, D. K. Auten.

Department of Poultry Science

-58	Metabolic and Nutritional Studies on Microorganisms Important to the Poultry Industry. Mary S. Shorb, Pauline G. Lund, Winifred R. Knuese, W. O. Pollard.
-59	Lipid Methabolism of Fowl Spermatozoa. Mary S. Shorb and Brian Dunlap.
-61	A Study of Causes of Bruising in Transportation of Live Broilers from Farm to Processing Plant and Possible Methods for Their Reduction. N. V. Helbacka, M. H. Taylor, James Nicholson, Paul Winn.

M-64	Effects of Gonadal Hormones on Embryonic and Postnatal Bone Growth in Chickens. E. F. Godfrey and C. S. Shaffner.
M-66	Applied Broiler Nutrition Studies. G. F. Combs, P. F. Twining, and E. H. Bossard.
M-67	The Effect of Processing on the Availability of Energy and Amino Acids in Wheat and Its By-Products. R. D. Creek.
M-68	Genetic Adaptation for Broiler Breeder Stock. C. S. Shaffner and E. F. Godfrey.
M-69	The Relationship Between the Activity of the Kreb's Cycle Enzymes and Fertilizing Ability of Fowl Spermatozoa. F. H. Wilcox and R. B. Buckland.
M-100	Quality Retention in Poultry Meats as Influenced by Methods of Processing. N. V. Helbacka, A. W. Kotula (USDA), David Wakefield (Computer Science Center), and Robert Wiley.
M-101	Studies of the Influence of Slush-Ice Chilling and Carcass Water Content on the Quality of Processed Poultry. D. E. Bigbee and N. V. Helbaka.
M-102	Studies of Factors Influencing Broiler Carcass Yields, and Microflora of Processed Broilers. Daniel Bigbee, Hal Taylor, C. S. Shaffner, and P. A. Hanson.
M-207	Study of Chicks Red Blood Cell Transketolase as an Index of Thiamine Nutriture. G. F. Combs, P. Padhi, and R. G. Peacock.
M-208	Use of Chick Bio-Assay in Measuring Specific Amino Acid Availability. G. F. Combs, E. Bossard, V. Vasaitis, and D. L. Blamberg.
M-209	Effect of Protein Level and Amino Acid Balance on Voluntary Food Consumption. G. S. Shaffner, G. F. Combs, D. L. Blamberg, V. Vasaitis and A. K. Khalil.
M-210	Determination of Amino Acid Requirements of Growing Broiler Chicks and Laying Hens. G. F. Combs, O. P. Thomas, V. Vasaitis, E. Bossard, J. Potter, and F. Shank.
M-303	The Performance of Populations of the Domestic Fowl as Influenced by Heritable Physiological Traits and by Genes with Known Pleitropic Effects. F. H. Wilcox, C. S. Shaffner, W. S. Cloud, and H. M. DeVolt.
M-304	Selection for Viability of Broiler Breeding Stock. C.S. Shaffner and E. F. Godfrey.
M-400	Effect of Protein Adequacy on the Efficiency of Selection for Early Fattening of Turkeys. C. S. Shaffner, G. F. Combs, and E. F. Godfrey.

Department Of Veterinary Science

D-52	Respiratory Disease of Poultry. F. K. Wills, Carol Snedeker, and I. M. Moulthrop.
D-58	A Study of the Epidemiology of Staphlococcal Mastitis (Bovines) Utilizing Phage Typing. E. J. Schultz.
D-59	The Investigation of Fluorescent Antibody Technique with Respiratory and Other Diseases of Poultry. H. M. DeVolt, R. L. Peters, Willene Keenum.
D-62	Infectious Diseases Affecting Reproduction in Cattle with Special Refrence to Vibriosis and Leptospirosis. F. S. Yancey and W. R. Anderson.
D-63	Study of Bovine Respiratory Diseases. S. B. Mohanty, M. G. Lillie.
D-64	An Investigation to Study the Propagation of Avian Viruses in Tissue Culture. H. M. DeVolt, V. W. Mayer, and Willene Keenum.
D-65	Studies on Etiology and Pathogenesis, Laboratory Diagnois and Chemotherapy of Bovine Lymphosarcoma. B. C Hatziolos.
D-66	A Study of the Toxic Substances Produced by Stachybotrys Atra. R. B. Johnson and H. M. DeVolt.

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